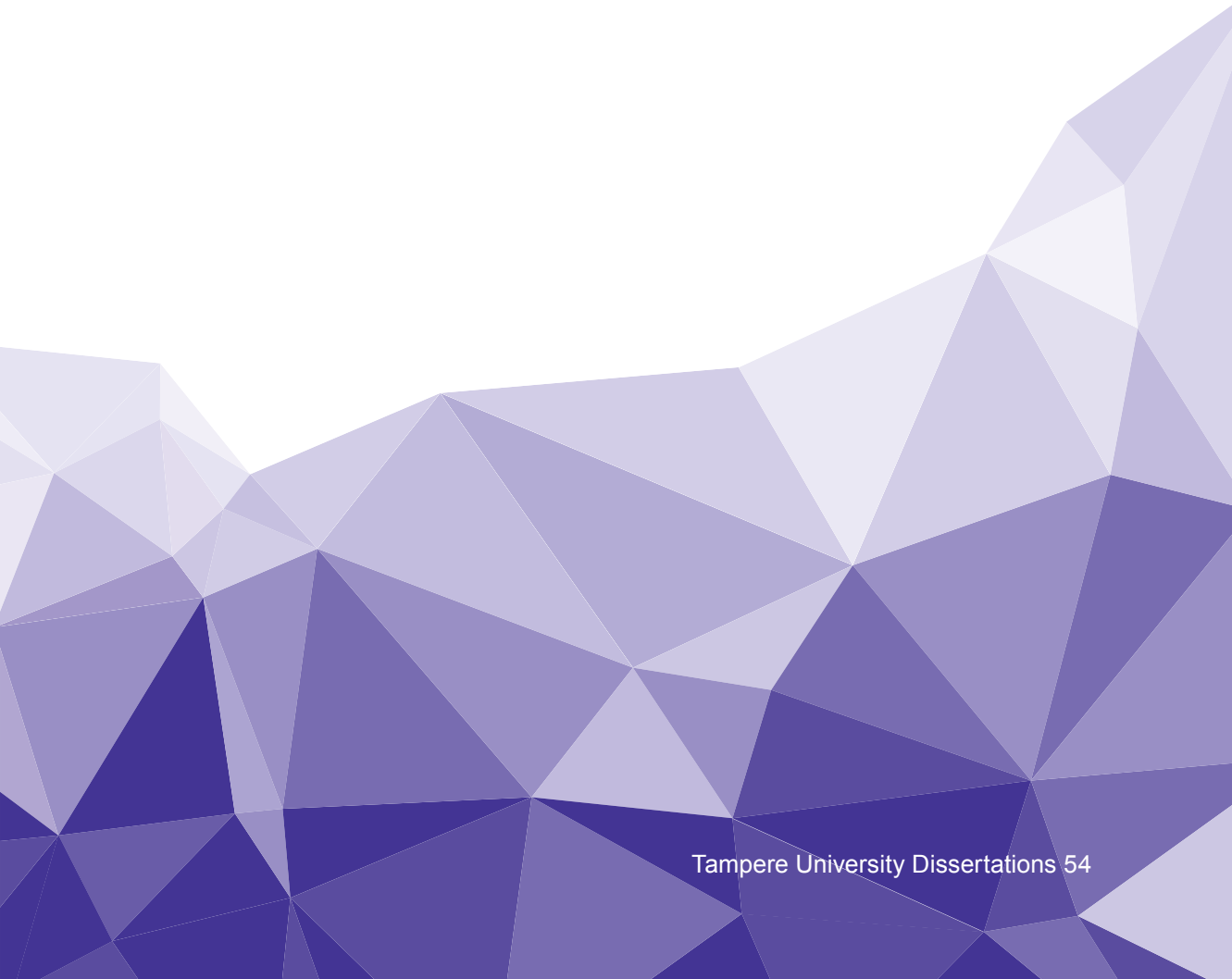
Tampere University

JOHANNA KIRJAVAINEN

Investigating Firm Performance Link with Product Line Length and Breadth



Tampere University Dissertations 54

Tampere University Dissertations 54

JOHANNA KIRJAVAINEN

Investigating Firm Performance Link with Product Line Length and Breadth

ACADEMIC DISSERTATION
To be presented, with the permission of
the Faculty Council of the Faculty of Engineering and Natural Sciences
of Tampere University,
for public discussion in the auditorium RG202
of the Rakennustalo building, Korkeakoulunkatu 6, Tampere,
on May 2nd 2019, at 12 o'clock.

ACADEMIC DISSERTATION
Tampere University, Faculty of Engineering and Natural Sciences
Finland

Responsible supervisor and Custos	Professor Saku J. Mäkinen Tampere University Finland	
Supervisor	Dr. Ulla A. Saari Tampere University Finland	
Pre-examiners	Professor Brian S. Silverman University of Toronto Canada	Professor Giovanni Battista Dagnino University of Rome LUMSA Italy
Opponent	Professor Kim Wikström Åbo Akademi Finland	

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

Cover design: Roihu Inc.

ISBN 978-952-03-1072-1 (print)
ISBN 978-952-03-1073-8 (pdf)
ISSN 2489-9860 (print)
ISSN 2490-0028 (pdf)
http://urn.fi/URN:ISBN:978-952-03-1073-8

PunaMusta Oy – Yliopistopaino
Tampere 2019

Pihlalle, Petrille ja tulevalle pikkuveljelle

PREFACE

When I look back at the moment I originally began writing this dissertation, it feels like it happened in another life. And in many ways, it did. The dissertation process has been a part of my life for such a long and remarkable period of time that I feel like I have grown up in the midst of it. Much of this growth is owed to this intense, educational and enlightening project, and especially to the people who took part in it with me. And as with any truly character-building experience, this one has not been without its challenges either. I have been extremely lucky to have had a number of extraordinary people help me get through them, and celebrate the successes with me.

First and foremost, I want to express my deepest and sincerest gratitude to my supervisor Professor Saku Mäkinen, whose help and guidance were invaluable. His enthusiasm, experience, and empathy made him truly a pleasure to work with. I am even more grateful for the fact that Saku's guidance was never limited to work-related issues only, but many of the most enlightening, analytic, and thought-provoking discussions during this process in fact had very little to do with the dissertation itself, at first glance at least, and more to do with life in general.

I would also like to thank my second supervisor, Dr. Ulla Saari, who provided valuable ideas and advice, and acted as vital peer-support when the challenges of the work seemed overwhelming. Ulla's passion and drive for research motivated me in finalizing the dissertation.

Furthermore, I am thankful for the insightful comments of the pre-examiners, Prof. Brian Silverman from the University of Toronto and Prof. Giovanni Battista Dagnino from the University of Rome LUMSA. Their thoughtful observations shaped this dissertation into its final form. Also, I want to thank Prof. Miia Martinsuo for reviewing the final draft of the dissertation and providing valuable and highly relevant feedback before the work was sent to the pre-examiners.

I was lucky to receive funding for my studies from the doctoral school of Tampere University of Technology, for which I am grateful. I also want to thank Dr. Andrei Rikkiev, Laura Valtonen, Maria Koudinova, Akseli Lahdensuo, Pauliina Mäkilä, Helinä Pohjola, Mikko Sairanen, Joel Salmela, and all of the other people who took part in the arduous task of gathering and cleaning the data used in this study.

During the dissertation process, I have had the privilege to spend time with a number of inspiring people. I am especially grateful to Lauri, with whom we have shared this entire journey from the very beginning of our university studies over a decade ago. All the great discussions and heated debates both at work and over a pint or two have been irreplaceable and have made us lifelong friends. I also wish to thank Natalia, Eija and Milla for their optimism and good humor, which often made my day. Thank you also to my former and current colleagues at CITER and at the department, with whom I got to spend time at both formal and informal surroundings over the years, and who offered help when I needed it.

As the dissertation project can often become quite intense, I am extremely thankful to all my friends outside the academia, who took my mind out of the work and gave me a chance to unwind and have fun. The significance of all those countless dinner parties, weekends spent together, picnics, sauna evenings, gigs, board games, and above all the delightful and thought-provoking conversations during these cannot be understated.

The foundations of a number of skills and attitudes needed to complete a dissertation were instilled into me by my parents. They taught me to value learning, to work hard for my goals, to believe in myself and my ability to complete the tasks I take on and not to give up in the face of setbacks and challenges. Their encouragement and belief in me has made all the difference.

Above all, I need to thank Petri. Your optimism, understanding, help, wisdom, humor, and trust in me have made this possible. We did not choose the easiest path for doing this, if that can be said about having two kids in the middle of one's doctoral studies, consequently not sleeping properly for almost two years, dealing with continuous ear infections, and learning to be parents all at the same time, but we have come out of it stronger, and for that I am grateful and proud. I could not hope for a better person to share my life with, nor a better father to our children.

Finally, I want to thank Pihla. Having you has taught me more about myself than anything ever before. You have taught me to be a mother, and reminded me of what is truly important in life. Your joyfulness and carefreeness have brightened my days, although some extra sleep would have been appreciated from time to time. I love you more than anything. Thank you also to the future baby brother for hanging in there and setting me a relatively firm deadline for finishing the dissertation. I cannot wait to meet you.

Tampere, April 9th, 2019
Johanna Kirjavainen

ABSTRACT

The introduction of completely new products and new versions and variations of a firm's old products enables firms to respond to increasingly heterogeneous customer needs, the intensified speed of technological development, and changing competitive conditions, making the strategy of increasing product variety a highly popular one. However, simply increasing product variety, that is, lengthening or broadening the firm's product line, does not always lead to better performance in the market, and might instead have detrimental effects on the firm's performance. Changes in the competitive intensity of the industry and other contingencies also influence the profitability and performance of different product line strategies.

This dissertation's objectives were to analyze the relationship between product line length and firm performance and product line breadth and firm performance and investigate the effects of competitive intensity on both of these relationships. The study distinguishes between product line length (i.e., the number of product variants in a product line) and breadth (the number of product lines a firm offers in a given industry submarket) and examines both constructs and their performance implications separately within the context of the global digital camera industry.

The quantitative analyses were conducted on a dataset of 2,033 new product introductions by digital camera manufacturers during the period 1999–2017. The performance of the firms was analyzed for the market as a whole and for three different product categories separately by utilizing a novel firm performance measure in the field of product line research: online customer evaluations. Partially consistent with previous research, the study found an inverted U-shaped relationship between product line length and firm performance in the digital camera market as a whole and in the compact product category. However, the U-shape only applied to firms operating with very short product lines, and for a vast majority of firms, the study recognized a negative linear relationship between product line length and firm performance. In terms of breadth, the results contradict the prevailing hypothesis of a U-shaped relationship, instead finding a negative linear one in the market as a whole and in the compact category in particular. Competitive intensity seems to strengthen the impact. No effect was detected for the bridge and SLR categories for either of the variables.

The findings indicate that environmental dynamics and other characteristics of product categories play an important role in determining the profitability of a product line strategy and whether active product line strategies are recommendable to cope with competition in the category. Studies on the topic have commonly analyzed an entire submarket as a homogeneous set of customers, products, and firms, not distinguishing between different categories within the submarket. This study questions the generalizability and applicability of one product strategy to an entire market, and recommends more detailed analysis of separate product categories to support decision making. Future research should analyze both product line length and breadth together and investigate further the potential differences between product categories in terms of product line strategy performance. The relationship between product line breadth and firm performance also merits further research.

TIIVISTELMÄ

Uusien tuotteiden ja tuotevariaatioiden tuominen markkinoille antaa yrityksille mahdollisuuden vastata yhtä vaihtelevimpiin asiakastarpeisiin, teknologisen kehityksen kiihtyvään vauhtiin, sekä muuttuviin kilpailuolosuhteisiin. Tämä on johtanut tuotevariaatioiden lisäämisen suosion kasvuun yritysten keskuudessa. Uusien tuotevariaatioiden esittely, eli tuotelinjan pituuden kasvattaminen, ei kuitenkaan aina johda parempaan suorituskykyyn markkinoilla, vaan sillä saattaa jopa olla haitallisia vaikutuksia yrityksen suorituskyvylle. Muutokset toimialan kilpailun intensiteetissä ja muissa tilannesidonnaisuuksissa saattavat myös vaikuttaa erilaisten tuotelinjastrategioiden kannattavuuteen.

Tämän väitöskirjan tavoitteena oli analysoida sekä tuotelinjan pituuden että tuotelinjan laajuuden suhdetta yrityksen suorituskykyyn, sekä tutkia kilpailun intensiteetin vaikutusta näihin suhteisiin. Tutkimuksessa erotetaan tuotelinjan pituus, eli tuotevariaatioiden määrä tuotelinjassa, tuotelinjan laajuudesta, eli yrityksen markkinalla tarjoamien tuotelinjojen määrästä. Näitä käsitteitä ja niiden vaikutuksia suorituskyvylle tutkitaan molempia erikseen globaalin digitaalikameramarkkinan näkökulmasta.

Kvantitatiiviset analyysit tehtiin datasetillä, joka sisälsi 2033 digikameravalmistajien vuosina 1999 – 2017 tekemää uuden tuotteen lanseerausta. Yritysten suorituskykyä analysoitiin koko digikameramarkkinalla, sekä kolmessa eri tuotekategoriassa erikseen käyttäen tuotelinjatutkimuksen näkökulmasta uutta suorituskykymittaria, internetissä asiakkaiden antamia tuotearvioita. Aiemman tutkimuksen kanssa osittain yhdenmukaisesti tämä tutkimus tunnisti tuotelinjan pituuden ja yrityksen suorituskyvyn välillä alaspäin aukeavan paraabelin muotoisen suhteen koko digikameramarkkinalla sekä kompaktikameroiden kategoriassa. Tämä suhde kuitenkin koski ainoastaan yrityksiä, joiden tuotelinjat olivat todella lyhyitä, ja suurimman osan yrityksistä kohdalla tuotelinjan pituuden ja yrityksen suorituskyvyn välinen suhde oli todellisuudessa negatiivinen. Tuotelinjan laajuuden osalta tulokset ovat ristiriidassa vallitsevan oletuksen kanssa ylöspäin aukeavan paraabelin muotoisesta suhteesta, ja tutkimuksessa huomattiinkin negatiivinen lineaarinen suhde koko kameramarkkinalla sekä kompaktikameroissa. Kilpailun intensiteetti

vaikuttaa vahvistavan tätä suhdetta. Mitään vaikutusta ei havaittu kahdessa muussa kamerakategoriassa.

Löydökset viittaavat siihen, että ympäristön dynamiikalla sekä muilla tuotekategorioiden ominaisuuksilla on merkittävä vaikutus tuotelinjastrategian kannattavuuteen ja siihen, onko tuotelinjapäätösten aktiivinen hyödyntäminen kilpailussa suositeltavaa. Aihealueen tutkimukset ovat yleensä analysoineet kokonaista markkinaa yhtenäisenä ja melko samankaltaisena asiakkaiden, tuotteiden ja yritysten joukkona, eikä erilaisia tuotekategorioita markkinan sisällä ole huomioitu. Tämä tutkimus kyseenalaistaa yhden tuotelinjastrategian soveltuvuuden kokonaiselle markkinalle sellaisenaan, ja suosittelee tuotekategorioiden yksityiskohtaisempaa analyysia päätöksenteon tueksi. Tulevaisuudessa tutkimuksen pitäisi pyrkiä analysoimaan yhdessä sekä tuotelinjan pituutta että laajuutta, ja toisaalta eroavaisuuksia tuotelinjastrategioiden suorituskyvyn suhteen eri tuotekategorioiden välillä. Myös tuotelinjan laajuuden ja yrityksen suorituskyvyn välistä suhdetta pitäisi tutkia lisää eri toimialoilla.

CONTENTS

1 INTRODUCTION

1.1 Background and motivation

"Which products to offer" and "which markets to serve" represent what are possibly the most important strategic choices a firm undertakes in its quest to survive and thrive in competitive environments (e.g., Corey 1975; Rumelt et al. 1991). The development and introduction of completely new products and new versions and variations of a firm's old products enables firms to respond to increasingly heterogeneous customer needs and the intensified speed of technological development, making the strategy of increasing product variety a highly popular one (Sawhney 1998; Shankar 2006; Sarangee and Echambadi 2014). Under changing competitive conditions, where firms need to adjust their strategies rapidly to cope with intensified competition, product line actions offer a potentially effective instrument.

How many variations of the same product should a company ideally offer, then? When are new product models beneficial for the firm, and are there certain circumstances in which they are not? How should product variety be used to successfully respond to changes in the competitive environment? Despite ample research on decisions related to product variety and its performance implications, researchers have yet to reach a consensus on these pivotal questions (Jeong et al. 2017). Nonetheless, a number of potential benefits of increased product variety have been identified, ranging from sustaining customer loyalty and increasing market share to meeting customer needs more accurately (Kekre and Srinivasan 1990; Klemperer 1995; Moreno and Terwiesch 2017). However, simply increasing variety does not always lead to better performance in the market, and it might instead worsen a firm's competitiveness through management and coordination difficulties and cannibalizing the performance of the firm's other products, for example (Quelch and Kenny 1994; Ramdas and Sawhney 2001; Axarloglou 2008).

Since virtually all firms nowadays have multiple different products that they offer to numerous different markets and as variety has increased exponentially in most consumer product categories (Clemons et al. 2006), information on the performance

effects of these strategic choices is vital for managers. In addition, if a firm's competitors constantly introduce new products and increase the variety they offer, or they actively prune their product lines to include fewer products, or if the industry is attracting the entrance of a number of new players, the firm's product line choices and the direction and magnitude of their performance benefits are likely to be significantly affected. Yet, managers should be able to take these contingencies into consideration in order to make informed decisions that improve the firm's overall performance in the industry.

The performance and success of a firm is, in turn, inherently tied to its ability to satisfy the customer by meeting their needs and expectations (Churchill et al. 1982; Anderson et al. 1994; Herrmann et al. 2000). Through increasing the length of their product lines, and thus offering more variety to cater to more diverse tastes, firms seek to respond to this challenge. One way to measure a firm's success in this respect is through online customer evaluations. It is highly common for customers today to seek knowledge on the quality of new products online before purchasing them (Clemons and Gao 2008; Zhu and Zhang 2010; Clemons 2008). In studies conducted on the topic, 78 percent of the participants reported trusting reviews by other customers, 64 percent spent 10 minutes or more reading reviews, and 68 percent read at least four product reviews before making their purchasing decision (Hu et al. 2014). Online customer reviews act as an important source of this information, significantly influencing customers' purchasing decisions and consequently affecting product sales as a whole (Godes and Mayzlin 2004; Liu 2006; Dellarocas et al. 2007). In the digital world, the power of word of mouth has increased manifold (Dellarocas et al. 2004), making it a measure worth utilizing and analyzing more carefully.

1.2 Research objectives

This dissertation is situated in the field of product line strategy research. In this study, a product line is considered *a group of products designed to perform a similar function and sold to similar customer groups in one product category* (Kekre and Srinivasan 1990; Giachetti and Dagnino 2014; Barroso and Giarratana 2013). Product line length refers to *the number of product variants in a product line* (Bayus and Putsis 1999; Putsis and Bayus 2001; Draganska and Jain 2005; Shankar 2006; Dowell 2006; Giachetti and Dagnino 2014; Jeong et al. 2017), and product line breadth refers to *the number of product lines a firm offers in a given industry submarket* (Barroso and Giarratana 2013). Some of the main reasons for the lack of generalizable knowledge on the nature and direction of the performance effects of product line decisions stem from the lack of consistent and

reliable definitions and measures of key concepts like product line length and breadth, and the lack of accurate measures for firm performance. Consequently, it is difficult to draw comparisons between the findings of product line studies. Due to the problematic nature of the concepts, it is necessary to begin this study with unambiguous definitions of both product line length and product line breadth. These definitions and their theoretical bases are discussed in more detail in the following chapter.

Firms' motives for increasing or decreasing the length or breadth of their product lines vary, but the overarching theme among all of them is rooted in the idea that product line decisions are seen as one of the most important strategic actions a firm can take when attempting to improve their position in a highly competitive industry in order to survive and prosper (Giachetti and Dagnino 2014; Jeong et al. 2017). Current product line research offers mixed results on the performance effects of changes in product line length, with some recent research arguing that the relationship is negative (Boulding and Christen 2009), others that it is positive (Moreno and Terwiesch 2017), and others argue that it follows an inverted U-shape (e.g., Barroso and Giarratana 2013). As such, there remains a need to analyze this relationship further. The first research question is formulated as follows:

> ***RQ1:*** *Is there a relationship between a firm's product line length and its performance, and if so, what kind of relationship?*

Most product line strategy research to date has focused on product line length and its performance effects, with only a few studies analyzing breadth explicitly (e.g., Barroso and Giarratana 2013). Moreover, the concepts of breadth and length have often been used interchangeably. Both constructs should, however, be considered separately, since their demands and potential for performance gains are very different and are based on their different qualities. Breadth has been found to have a rather opposite effect on performance when compared to length, as researchers have found support for a U-shaped relationship (Dowell 2006; Barroso and Giarratana 2013) and a positive one (Giarratana and Fosfuri 2007). In all, research on the topic has been quite scarce. The second research question is thus posed:

> ***RQ2****: Is there a relationship between a firm's product line breadth and its performance, and if so, what kind of relationship?*

The complexity of determining the strength and direction of the potential relationship between firm performance and product line decisions is further increased by the fact that industry conditions play a major role in shaping it. The evolution of competition in the industry is, in part, driven by the intensity of competition (Porter 1979a), and the significance of competitive intensity as a concept is emphasized by its influence on diverse constructs, from profitability (Bettis and Weeks 1987) and pricing (Gimeno and Woo 1999), to potential market share gains (Ferrier et al. 1999) and the survival of firms in general (Barnett 1997). Competitive intensity has a considerable effect on determining the competitive environment of an industry and how firms cope within it, and adjusting the length or breadth of their product line can be viewed as one potential mechanism a firm may use to respond to changes in the industry (Giachetti and Dagnino 2014; Jeong et al. 2017).

So far, a few researchers have considered a firm's competitive environment in terms of intensity of competition. They have found that the performance effects of lengthening a firm's product line, for example, might in fact change from positive to negative as competition intensifies in the industry (Sorenson 2000; Giarratana and Fosfuri 2007; Jeong et al. 2017) and that firms adjust their product lines according to these changes (Giachetti and Dagnino 2014; Jeong et al. 2017). However, most of these studies have very differing takes on competitive intensity, and the measures used differ accordingly.

The idea of taking product line actions as a way of coping with changes in competition is rooted in the competitive dynamics view (e.g., Chen et al. 1992), which focuses on competitive actions as a means of pursuing competitive advantage (Chen and MacMillan 1992). Only a few very recent studies have taken the competitive dynamics view, focusing on product line actions as competitive actions (Giachetti and Dagnino 2014; Jeong et al. 2017). However, no study has yet analyzed the effects that competitive intensity might have on broadening product lines. Consequently, the final two research questions are as follows:

> ***RQ3:*** *Does competitive intensity have an effect on the relationship between product line length and firm performance?*

> ***RQ4:*** *Does competitive intensity have an effect on the relationship between product line breadth and firm performance?*

Answering these questions should advance the field of product line research by offering insight into the performance effects of product line decisions through both length and breadth considerations. This study also presents a novel approach to firm performance measurement, proposing using online customer evaluations of products as a firm performance measure. These evaluations have been found to considerably influence the sales of a firm's products (Dellarocas et al. 2004; Park et al. 2007; Lin et al. 2011) and depict customers' satisfaction with them (Engler et al. 2015). Since customer satisfaction is in turn directly linked to firm performance (e.g., Williams and Naumann 2011), and there are problems with many of the performance measures currently being used (Carton and Hofer 2010; Lieberman and Montgomery 2013), a study of online customer evaluations as a measure of firm performance seems warranted.

From a managerial point of view, the results of the dissertation should help in analyzing firms' product line strategies and the effects that the current competitive environment should have on them. Making well-informed decisions on these topics can improve resource allocation, customer satisfaction, sales, market share, and profit, as well as prevent common pitfalls like cannibalizing one's own products and lowering profit margins due to higher unit and inventory costs.

1.3 Scope and limitations

The objectives of this dissertation are to analyze the direction and magnitude of the relationships between product line length and firm performance and product line breadth and firm performance and study the effect of competitive intensity on these relationships. The dissertation is delimited in two major ways, namely by the theoretical point of departure and the data and methods of analysis.

First, the theoretical framework of the study is mainly confined to competitive dynamics and strategic product line research. A number of other potential theoretical streams are also touched upon in order to provide a fuller picture of the two main theoretical constructs of competitive intensity and product lines, but they are mainly used to complement the selected theoretical framework and are not presented in detail. For competitive intensity, these include institutional ecology, organizational ecology, strategic groups, and perspectives from marketing research, among others. For product lines, these include adjacent and somewhat interlinked concepts such as product differentiation, diversification, variety management, product line optimization, and customer needs and brand strategies.

Second, there are limitations to the data and methods used in the study. The analyses are based on the introduction of new products by firms in one specific industry—namely, the digital camera industry—between January 1, 1999 and December 31, 2017, and the cameras included are those for which information was publicly available online. The analyses use customer evaluations as a proxy for firm performance, which limits the scope of the data and analyses to this construct, not taking into account other performance measures. Following the existing literature investigating firm performance antecedents, the study also assumes a linear relationship between the variables, using hierarchical multiple regression and moderated multiple regression as methods of analysis.

1.4 Structure of the dissertation

This dissertation consists of five main chapters, as depicted in Figure 1. The first chapter serves as an introduction, which presents the background and motivation for the study, as well as its key constructs. It defines the research questions and objectives and the scope of the study.

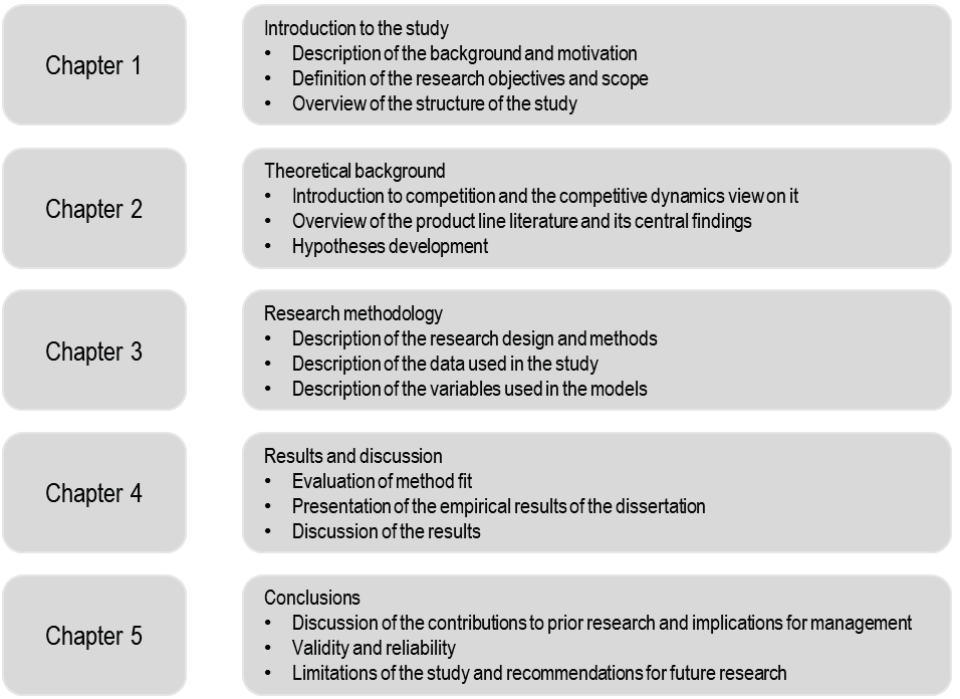


Figure 1. Structure of the dissertation.

The second chapter is divided in three parts and summarizes the relevant literature on the main research themes of competition and product lines. The first part focuses on the competitive dynamics view on competition and competitive intensity, while the second part discusses the key themes and findings of the product line strategy literature and defines the concepts of product line length and breadth. The third part presents the hypotheses of the study based on the current literature on the topic.

The third chapter describes the research design and methods used to analyze the data. It also provides a detailed account of the data and models of the study and discusses the variables utilized in the quantitative analyses.

Chapter 4 evaluates the fit of the selected quantitative method before presenting the results of the study. The results are divided into two parts so that product line length and breadth are both discussed separately. Finally, the results are discussed in relation to the previous literature.

The fifth chapter examines and evaluates the theoretical and managerial contributions of the study and the limitations of the results. Potential future research avenues are also considered.

2 THEORETICAL BACKGROUND

2.1 Competition

Competition, which is "the activity or condition of striving to gain or win something by defeating or establishing superiority over others" (The Oxford Dictionary of English 2005), is a constant condition in industries. Indeed, in an effort to improve their relative performance and market share, and even to survive, firms often engage in competition by directly challenging their competitors (Porter 1985; Ferrier 2001). The means of competition vary, but they often consist of price cuts, advertising campaigns, introducing new products, increasing capacity, or signaling competitive intentions, among others (Ferrier et al. 1999; Ferrier 2001; Chen and Miller 2012). Based on its own considerations, a firm may use different combinations of actions that serve its purposes in order to cope with the changes in its competitive environment.

To survive in an industry and remain competitive, firms seek to achieve a sustained competitive advantage vis-à-vis their rivals (Porter 1985). The notion of gaining a sustained competitive advantage through engaging in specific competitive strategies has received considerable attention in the past (e.g., Barney 1991; Oliver 1997), but a more dynamic view on competition and strategy has questioned the possibility of achieving such an advantage and instead cautioned that competitive advantage is inherently short-lived (D'Aveni 1994). Since product lifecycles and product development cycles have become increasingly short, and phenomena such as globalization, industry convergence, deregulation, and a faster pace of technological change have shaped industry landscapes, firms need a constant stream of competitive actions to create new temporary advantages (D'Aveni 1994; D'Aveni et al. 2010). Following this dynamic strategy research stream, firm-level competitive actions form the core of a firm's strategy and competitive positioning (Chen et al. 1992; Young et al. 1996). Consequently, competitive actions are the tools firms use to gain and maintain a competitive advantage under various levels of competitive intensity (Bettis and Weeks 1987; MacMillan et al. 1985).

The intensity of the competition in an industry is an important and influential aspect of its competitive environment, affecting resource availability (Barnett 1997),

profitability (Bettis and Weeks 1987), potential market share gains (Ferrier et al. 1999), predictability (Auh and Menguc 2005), pricing (Gimeno and Woo 1999), market positioning (D'Aveni 1994), firms' product line decisions (Giachetti and Dagnino 2014; Jeong et al. 2017), firms' strategies in general (D'Aveni 1994; Gimeno and Woo 1996), and firms' very survival (Barnett 1997). Thus, competitive intensity plays a key role in determining the competitive environment of an industry and how firms cope with it.

A number of concepts have been used interchangeably in the literature in relation to competitive intensity, such as competitive tension (Chen et al. 2007), competitive pressure (Sinha and Noble 1997), competitive threat (Mitchell 1989), competitive turbulence (Cadogan et al. 2001), and the level and intensity of industry rivalry (Porter 1980; Young et al. 1996; Baum and Korn 1996). Diverse streams of literature have considered the concept from multiple perspectives, which are briefly outlined below to paint a fuller picture of the construct. The last part of this chapter focuses on competitive intensity according to the competitive dynamics view, which is the main theoretical framework used in this study to analyze competition.

One perspective commonly cited in the marketing literature defines competitive intensity as "a situation where competition is fierce due to the number of competitors in the market and the lack of potential opportunities for further growth" (Auh and Menguc 2005; Chan et al. 2012). As competition intensifies, the results of a firm's behavior are harder to predict because the behavior is strongly influenced by the actions and contingencies of the firm's competitors (Auh and Menguc 2005). Competitive intensity has been viewed as a central component in moderating the effect of market orientation and firm performance (e.g., Jaworski and Kohli 1993; Cadogan et al. 2003).

By contrast, under the institutional ecology perspective, Barnett (1997) has considered a firm's competitive strength as identical to competitive intensity, which he defines as "the magnitude of effect that an organization has on its rivals' life chances." Barnett's definition thus differs markedly from the others, since it views competitive intensity as a firm-specific quality instead of an industry-level attribute. This firm-level view posits that organizations are themselves able to influence their competitive intensity, exerting their power and institutional advantages to improve their market position over their competitors (Barnett 1997; Mezias and Boyle 2005). Thus, the presence of stronger competitors than the focal firm will likely increase competitive intensity and affect the actions the firm takes in response to its competitors' actions (Ang 2008). Similarly, increased competitive intensity often

leads to a reduced number of competitors in the industry, weeding out those unable to adapt to changes in the environment (Ramaswamy 2001).

The organizational ecology literature, in turn, suggests that competitive intensity is dependent on the similarity of rival firms in terms of their resource requirements (Baum 1999). Higher similarity in resource requirements increases the potential for intense competition (Hannan and Freeman 1977; Hannan and Freeman 1989). Under this stream, the density dependence theory assumes that the intensity of competition in a population of organizations is dependent on the total number of organizations in said population (Carroll and Hannan 1989; Baum 1999).

Within the strategy research stream, the strategic group literature has also focused on competitive intensity and how it is affected by intra-industry heterogeneity (e.g., Porter 1976; Porter 1979b; Caves and Porter 1977; Cool and Dierickx 1993; Peteraf 1993). The strategic group literature has analyzed the effects of the number and size distribution of groups, the strategic distance between groups, the market interdependence among groups, and within-group or between-group rivalry on rivalry intensity and industry profitability (Porter 1976; Cool and Dierickx 1993). Rivalry intensity is also one of the drivers of competition in Porter's (1979a) well-known five forces model. In his view, rivalry intensity refers to the extent to which firms pressure each other and limit each other's profit potential within an industry. Rivalry intensity is conditioned by the number of firms in the industry (i.e., industry concentration), for example (Porter 1980). The five competitive forces of industry rivalry, barriers to entry, bargaining power of customers, bargaining power of suppliers, and the threat of substitute products or services all determine the overall competitive intensity of an industry (Porter 1979a).

As the focus of this study is on the product line strategies firms utilize to compete with each other under changing competitive conditions, this chapter discusses the different aspects and measures of competition in the existing research. The following chapter specifically addresses the topic from a competitive dynamics point of view.

2.1.1 Competitive dynamics

The competitive dynamics literature focuses on the link between competitive actions and competitive advantage (Chen and MacMillan 1992). It is argued that each individual action of a firm is a basic building block of competitive advantage (Schumpeter 1934; Porter 1991), and the pattern forged by all the different moves together constitutes the firm's strategy (Mintzberg and Waters 1985; Chen and Miller 2012).

Within the field of strategic management, inter-firm competition has been the focus of attention under a number of research streams, from industrial economics and structural analysis (Porter 1980) to population ecology (Hannan and Freeman 1977) and competitive dynamics (Baum and Korn 1996; MacMillan et al. 1985; Chen and Miller 1994), to name a few. The distinct difference between these views on competition is in their levels of analysis: in the two former streams, competition is considered a property of market, industry, or population, and not subject to the actions of individual firms (Tirole 1988; Hannan and Freeman 1989; Baum and Korn 1996). In the competitive dynamics stream, competition is interactive and dynamic, and it is viewed as composed of a series of actions and reactions by the focal firm and its rivals, which together make up the competitive dynamics of an industry (Smith et al. 2001).

This field of research has attracted significant attention because competitive dynamics offers a dynamic and close view of both competition and firm strategies through the analysis of individual firm actions and rivals' reactions (Smith et al. 1991; Chen and Miller 2015). The following first briefly reviews the origins of competitive dynamics research in Austrian economics and then moves on to discuss the defining features and key concepts related to it. Finally, the current status of the research stream and its linkages to other relevant streams are presented.

Theoretical foundations

The roots of competitive dynamics research lie in Schumpeter's (1934; 1942) theories, especially that of creative destruction (Smith et al. 2001; Chen and Miller 2012; Chen and Miller 2015). Schumpeter used the concept of 'creative destruction' to describe the dynamic process of competition in which firms act and react in order to pursue market opportunities (Schumpeter 1942). He defined it as the inevitable market decline of formerly leading firms through the process of competitive actions and reactions taken by the firm and its rivals. In his view, some firms act in order to gain a lead, whereas others follow the leader and imitate its actions (Smith et al. 1991). The leader might succeed in earning abnormal profits through achieving a monopolistic position that it can exploit during the time it takes for its rivals to respond (Nelson and Winter 1982). The rivals, in turn, are motivated by the extraordinary profits gained by the first-moving firm, and they undertake actions and reactions with the aim of overtaking the leader and enjoying the same profits. Schumpeter described this dynamic process as a 'perennial gale.' Inherent in the idea of competition as a perennial gale is the notion that no competitive advantage is

permanent; rather, all such advantages will eventually erode through competition at one point or another (Grimm et al. 2005).

The main feature of Schumpeter's theory (underlying the theory of competitive dynamics) is the idea that instead of being a mere static outcome, as posited by the neoclassical economists, competition is a dynamic market process through which the uninterrupted stream of actions and reactions constantly alters the market environment (Smith et al. 2001). The same notion is central to Austrian economics, as well (Jacobson 1992). The Austrian economists believe that a perfect market equilibrium can only occur in the complete absence of competition, which is a state of affairs that can never take place; consequently, they see markets as constantly moving toward and away from equilibrium (Schumpeter 1934; Mises 1949; Jacobson 1992). This movement is caused by the innovative actions that firms take to better fulfill consumer needs and respond to market opportunities, which is defined as 'entrepreneurial discovery.'

Many of the key concepts of competitive dynamics are rooted in Austrian economics, including the focus on action, response timing, industry structure, and competition (Smith et al. 2001). Interested in the idea of the abnormal profits accrued during the lag between rivals' responses, competitive dynamics research has focused a lot of attention on identifying strategic actions that benefit from this lag or can be used to maximize it (Chen and MacMillan 1992; Smith et al. 2001). Stemming from the idea of entrepreneurial discovery, researchers have studied innovative actions, the advantages gained through them, and their effects on markets and profits (Smith et al. 2001).

Key concepts and research streams

Competitive dynamics is a term that has been used in various settings, from biology and competition among species to game theoretic studies and studies on competition between different organizational forms (Chen and Miller 2012). However, as the focus of this study is on product strategies and competition, this dissertation focuses on the view that is most prevalent within the dynamic strategy research stream, which is that competitive dynamics is the study of inter-firm rivalry based on competitive actions and reactions, their contexts, drivers, and effects on competitors, competitive advantage, and performance (Baum and Korn 1996; Smith et al. 2001; Chen and Miller 2012). This definition especially highlights the research stream's three essential characteristics: 1) the emphasis on micro-level individual actions, action/reaction dyads, and streams of actions; 2) the interdependence and interaction between firms

that is inherent in the research; and 3) relativity, meaning that a firm's strategy and performance are considered in relation to its competitors' and within the context of the competitive environment in which the firm and its competitors find themselves (Miller and Chen 1996b; Smith et al. 2001; Chen and Miller 2015).

The first empirical studies applying these basic ideas were conducted in the 1980s by MacMillan, McCaffery, and van Wijk (1985), Bettis & Weeks (1987), and Smith, Grimm, Chen, and Gannon (1989). These articles analyzed competitors' response lags and product moves, rivals' countermoves, and action characteristics eliciting quick responses from rivals, respectively. The early 1990s witnessed a surge in competitive dynamics research, as a series of articles analyzing the competitive actions and reactions of firms in the US airline industry were published (Chen et al. 1992; Chen and MacMillan 1992; Smith et al. 1991; Miller and Chen 1994; Chen and Miller 1994; Chen and Hambrick 1995; Miller and Chen 1996a; Miller and Chen 1996b; Gimeno and Woo 1996).

Competitive dynamics research has since emerged as a rich field of study that has attracted ample interest from academics and practitioners alike. Researchers have found consistent support in multiple robust studies for the advantages of acting fast, acting aggressively, and acting in a more complex and unexpected manner in comparison to one's competitors, for example (Smith et al. 2001). Since the number of studies in competitive dynamics picked up in the 1990s, there have been numerous attempts to consolidate and harmonize the field, as well as provide new directions for research. These include the work of Smith et al. (2001), Ketchen et al. (2004), Chen and Miller (2012; 2015). Chen and Miller (2012) distinguished five separate, yet interconnected, research streams under the concept of competitive dynamics: 1) competitive interaction: action-level studies; 2) strategic competitive behavior: business-level studies; 3) multimarket and multibusiness competition: corporate-level studies; 4) integrative competitor analysis; and 5) competitive perception. The next section briefly outlines the basics of each of these streams, as presented in Figure 2. This approach will portray the multiple diverse aspects of the literature stemming from the core concept of competitive dynamics as a whole.

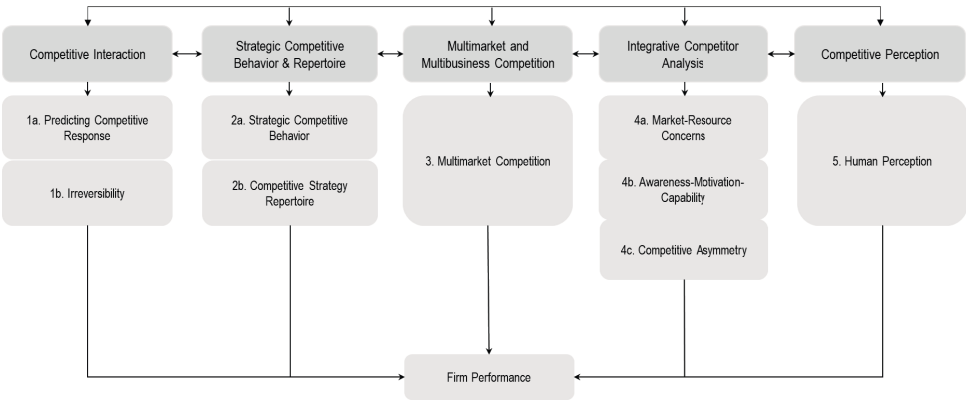


Figure 2. Competitive dynamics research streams (adapted from Chen and Miller 2012).

The first stream of research takes an action-level view and has focused on competitive interaction in terms of individual actions and responses to them—a view originating from the emphasis of Austrian economics on firm action. In competitive dynamics, an action can be defined as an "externally directed, specific, and observable competitive move initiated by a firm to enhance its relative competitive position" (Smith et al. 2001). A response, on the other hand, is "a specific and datable countermove, prompted by an initial action that a firm takes to defend or improve its share or profit position in its industry" (Chen and Miller 2012).

This stream is what initiated competitive dynamics literature, and MacMillan et al. (1985) were the first to focus on the micro-level of an action/response dyad—the level where competitive interaction actually occurs—instead of the previous macro-level focus on the firm (Dess and Beard 1984), strategic group (Cool and Schendel 1987), industry (Porter 1980), and population (Freeman et al. 1983; Chen and Miller 2012). This stream includes studies on characterizing and predicting competitive response, in which scholars have studied, for example, the likelihood of response (Chen et al. 1992) and the number and speed of responses (Boyd and Bresser 2008). In the same vein, researchers have studied the irreversibility of actions (e.g., Chen et al. 2002). Some of the key findings in this line of research have drawn the conclusion that when attacked in their key markets, competitors tend to react decisively, and that there exists a positive relationship between firm performance and competitive activity (Young et al. 1996) and firm performance and rivals' response lag (Smith et al. 2001).

The second stream of research is that of business-level studies on strategic competitive behavior and repertoire. These studies analyze the organizational and contextual antecedents of competitive behavior and competitive repertoire and their

performance implications. For example, researchers have noted that the size of a firm (Chen and Hambrick 1995) and the characteristics of its top management team (TMT) play a role in defining a firm's competitive behavior (Derfus et al. 2008; Hambrick et al. 1996; Ferrier and Lyon 2004). This stream has also focused on the simplicity or diversity of competitive moves made by a firm and its overall aggressiveness, influenced by industry characteristics such as growth and concentration, as well as a firm's past performance, organizational slack, and TMT heterogeneity (Miller 1993; Ferrier and Lee 2002).

The third stream of research concerns multimarket and multibusiness competition. Multimarket competition refers to a situation in which firms encounter the same competitors in multiple markets, thus they have multimarket contact (Gimeno 1999). This stream has stemmed from the mutual forbearance hypothesis that was first introduced by Edwards (1955). The theory holds that firms that operate in the same markets recognize their interdependence and thus aim to design their competitive interaction in order to minimize the risk of retaliation and escalation, thereby resulting in a situation in which a firm's aggressiveness toward its competitor is tempered by the possibility of multimarket retaliation (Edwards 1955; Baum and Korn 1996; Chen and Miller 2012). Viewing multimarket competition through the lens of competitive dynamics has enabled the analysis of inter-firm competition at the corporate level.

The fourth stream consists of approaches that integrate other important constructs of competitor analysis into the research domain. Chen and Miller (2012) consider it to be incorporating three different domains, those of market-resource concerns, competitive asymmetry, and the awareness-motivation-capability (AMC) framework. The market-resource concerns domain integrates the firm-specific concepts of market commonality and resource similarity in order to understand the tension between two competing firms and predict their competitive interaction (Chen 1996). The notion of market commonality is derived from the research on multipoint competition, which was discussed in the previous paragraph. It refers to the degree of presence a competitor manifests in the markets in which it overlaps with the focal firm (Chen 1996). Resource similarity, on the other hand, stems from the resource-based view (Barney 1991), referring to the extent to which a competitor possesses strategic resources (endowments) comparable in type and amount to those of the focal firm (Chen and Miller 2012). The idea behind competitive asymmetry is that competitive relationships between firms are rarely symmetrical in terms of the aforementioned concepts (Chen 1996).

The third domain under this stream is that of the AMC model, which is discussed in more detail due to its importance in portraying the antecedents of firms' competitive activities. The AMC framework was coined by Chen (1996) to provide an integrative framework on the antecedents underlying, for example, the likelihood, timing, shape, strength, and other characteristics of a focal firm's actions and the responses of its competitors (Chen and Miller 2012). Drawing from research on organizational change, learning, and decision-making, Chen has identified three behavioral drivers that influence a firm's decision to act or react (Chen 1996). The basic premise of the framework is that in order to respond, a competitor needs to be *aware* of the action made by the focal firm, *motivated* to react to it, and *capable* of responding (Chen 1996).

Awareness is considered a fundamental prerequisite to any action or reaction (Chen 1996). A competitor cannot and will not respond if it has not detected an action made by the focal firm (Chen and Miller 2012). Hence, awareness refers to how informed a firm is in terms of its competitors, the drivers of competition within the industry, and the competitive landscape as a whole (Smith et al. 2001). The level of awareness is a representation of the extent to which a firm comprehends the consequences of both its own actions and those of its rivals within the competitive landscape (Chen 1996).

However, a firm can be aware of the actions of its rivals and the general competitive environment but still not necessarily be motivated to respond (Smith et al. 2001). The theoretical foundations for the motivation and capability dimensions of the AMC model are derived from expectancy–valence theory (Vroom 1964; Lawler and Porter 1967; Yu and Cannella 2007). According to the expectancy–valence view, the inclination to act is influenced by the subjective reward value (valence) of acting effectively and the perceived probability or the expectation of earning a reward through effective action (expectancy) (Vroom 1964; Lawler and Porter 1967). Motivation thus relates to the focal firm's perception of whether it believes it stands to gain from an action or lose if no action is taken, i.e., whether it is incentivized to act (Smith et al. 2001). For example, if a new product introduction is seen as attacking a central strategic position and as having high potential, a quick response from rivals is often elicited (MacMillan et al. 1985).

Even if a firm were aware of a competitive move undertaken by its rival and there was enough at stake to motivate it to react, it might not have the capability to do so (Vroom 1964; Yu and Cannella 2007). The ability to take action is dependent on the skill of the firm in understanding the competitive environment, formulating effective plans for actions and reactions, understanding and utilizing the resources and

capabilities of the firm, and predicting the likely reactions of its competitors (Tsai et al. 2011; Chen and Miller 2012). This perspective is linked to the resource-based view that highlights the role of resources and capabilities in gaining and sustaining a competitive advantage (Barney 1991). Firm resources enable competitive action, and if they are not readily available, a firm may delay its response or not react at all (Ndofor et al. 2011; Yu and Cannella 2007).

Finally, the fifth stream of competitive dynamics research addresses competitive perception. These studies recognize that all action takes place via human agency, which is filtered by perception (Staw 1991). The relevance of perception is present in the AMC framework as well, since all of its elements are markedly affected by the perceptions of managers at the focal firm. In addition to the AMC, researchers have focused on perceived competitive tension (Chen et al. 2007), TMT dynamics (Le Breton-Miller et al. 2011), and the subjective intensity of rivalry between individuals, groups, and companies (Kilduff et al. 2010).

The aforementioned streams of competitive dynamics research draw from a wide variety of theoretical fundaments, integrating multiple perspectives from different theoretical backgrounds. Besides Austrian economics, competitive dynamics studies have utilized a plethora of different paradigms, ranging from evolutionary theory and organizational ecology to industrial organization economics and the strategic groups perspective, to name only a few (see Chen and Miller 2012).

Actions and reactions

Competitive actions and reactions are at the very heart of competitive dynamics theory. Through them, firms attempt to gain and maintain competitive advantage, erode rivals' advantage and improve their own performance (Ketchen et al. 2004; Smith et al. 2001). Firms position themselves through their own actions and their reactions to the competitive moves undertaken by their rivals, and this constant stream of moves and countermoves forms the core of a firm's strategy (Porter 1980; Mintzberg and Waters 1985). Figure 3 presents the basic relationship between competitive interaction, the competitive advantage created through it, and firm performance.

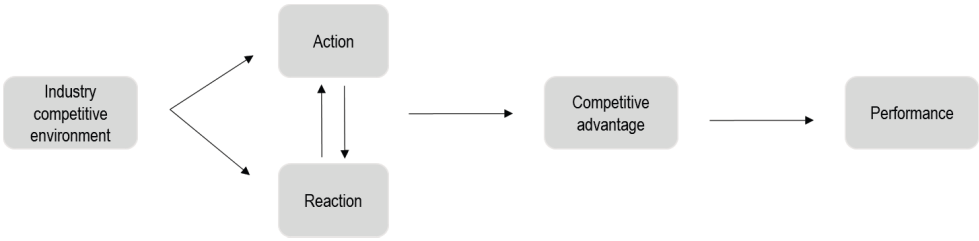


Figure 3. The competitive advantage and performance of firms is affected by the actions and reactions undertaken by the firm and its rivals, which in turn are affected by the industry competitive environment (adapted from Ketchen et al. 2004 and Smith et al. 2001).

Following their significance, a plethora of competitive dynamics research has been devoted to the characteristics, antecedents, and drivers of competitive actions, as well as the characteristics of competing firms and their responses (Ketchen et al. 2004). A rival's action is a signal, a message that is either direct or implied, and other firms need to evaluate it carefully and react accordingly in order to compete successfully (Smith et al. 1991). Market signaling can be described as any observable action by a firm that provides a direct or indirect indication of its current activities, intentions, motives, goals, results, or internal situation (Porter 1980, p.75; Fombrun and Shanley 1990; Ferrier 1997). According to Porter (1980, p.75), rivals may bluff or warn their competitors through their actions, or they may also signal an earnest commitment to a course of action.

Typical examples of competitive actions include the introduction of new products, product improvements, price cuts, expansion to new markets, and advertisement campaigns (Andrevski et al. 2016), generally constituting action categories such as pricing actions, marketing actions, new product actions, capacity- and scale-related actions, service and operations actions, signaling actions, and the like (Smith et al. 1991; Chen and MacMillan 1992; Smith et al. 2001). Researchers have analyzed the characteristics of actions and reactions, as well as the characteristics of competitive repertoire composed of the range of a firm's competitive moves, and those of the sequence of competitive actions taken by a firm. The concepts and attributes analyzed under each of these notions are presented in Figure 4.

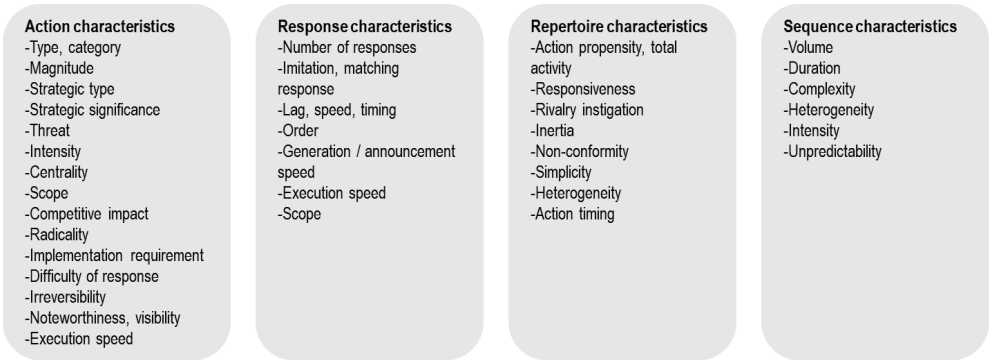


Figure 4. Characteristics of actions, responses, action repertoires, and sequences of actions (adapted from Smith et al. 2001).

Smith et al. (2001) synthesize the views of a number of competitive dynamics researchers in defining competitive action as an "externally directed, specific, and observable competitive move initiated by a firm to enhance its relative competitive position". Chen and Miller (2012) similarly define a response as "a specific and datable countermove, prompted by an initial action that a firm takes to defend or improve its share or profit position". The research on action characteristics has found, for example, that certain attributes of an action, such as its magnitude, scope, radicality, irreversibility, and visibility serve as predictors of response characteristics such as the likelihood and speed of response (Chen et al. 1992; Smith et al. 2001). Studying and understanding the effects of action characteristics is important, as it might provide firms ways of avoiding rival's retaliatory action, which has been found to negatively affect firm performance (Chen and Miller 1994).

In addition to the aforementioned action categories, researchers have taken into account the strategic type of an action (strategic versus tactical), the strategic significance of the market under attack for the rivals, and scope in terms of the number of competitors affected by an action (Chen et al. 1992; Smith et al. 1992). Strategic actions, such as new product introductions and manufacturing capacity changes, require a greater degree or organizational and resource commitment in contrast to tactical actions, such as price changes and promotions (Smith et al. 1991; Chen and Miller 2012). Actions that are strategic in nature tend to reduce both the number (Chen and Miller 1994) and speed of competitor's responses (Smith et al. 1991). The radicality of an action, i.e. the degree to which it departs from existing industry norms, has been found to elicit fewer and slower responses, as radical actions are more difficult to interpret (MacMillan et al. 1985; Smith et al. 1989; Chen and MacMillan 1992).

The threat, intensity, and centrality constructs refer to the degree to which an action threatens specific markets or customers of a rival, and how strongly a competitor is affected by an action (Chen et al. 1992; Smith et al. 1992; Chen and Miller 1994; Smith et al. 2001). Threat has been measured as the number of customers the rival is at risk of losing as a consequence of the action, whereas the number of competitors potentially affected by an action has been used to analyze action scope (Chen et al. 1992). A rise in the degrees of both scope and threat has been found to increase the likelihood and speed of response (Smith et al. 1992).

The extent to which a firm is irrevocably committed to economic investments or reorganizing as a consequence of a competitive action is referred to as action irreversibility (Chen and Miller 2012). Earlier research found irreversibility to increase the likelihood of response (Chen and MacMillan 1992), but later analysis distinguished between irreversibility internal to the firm and external to the firm, for example top management's public endorsement of an action, concluding that the former tends to escalate competition, while the latter tends to constrain it (Chen et al. 2002). Some central findings have also included the fact that a greater number of total actions carried out with greater average speed implies better profitability or market share (Young et al. 1996; Ferrier et al. 1999).

Apart from singular actions, focus has also been given to firms' competitive repertoires, i.e. all the competitive actions a firm has carried out within a given year (Smith et al. 2001). Under this construct, repertoire simplicity, nonconformity, and inertia have been analyzed. Simplicity refers to a competitive repertoire that overwhelmingly consists of a single type of action (Miller and Chen 1996b), whereas nonconformity is considered as the tendency of a firm's repertoire to depart from industry norms (Miller and Chen 1996a). Competitive repertoire inertia, in turn, refers to the level of activity in a firm when it alters its competitive stance through the number of market oriented changes (Miller and Chen 1994; Smith et al. 2001).

Additionally, firms' uninterrupted sequence of actions has received attention from researchers, due to the view stemming from the overarching idea of strategy in competitive dynamics as a coordinated, consistent, pattern of actions (Chen and Miller 2012). This notion has its roots in earlier strategic management literature, that has viewed strategy as patterns or consistencies in streams of behaviors (Mintzberg and Waters 1985), a chronological sequence of events that unfold over time (Van de Ven 1992), a coordinated series of actions (Maccrimmon 1993), and a simultaneous and sequential strategic thrust consisting of many actions (D'Aveni 1994). In competitive dynamics research, strategy at the action sequence level has been defined as "the ordered pattern of repeatable competitive actions carried out

in strategic time" (Ferrier 2001; Ferrier and Lee 2002). In terms of action sequence, its volume, duration, complexity, unpredictability, and heterogeneity have been studied (Ferrier 2001; Ferrier and Lee 2002; Smith et al. 2001).

2.1.2 Competitive intensity

The competitive dynamics literature has taken a firm-level view on the characteristics of competitive intensity, considering actions and responses, their aggressiveness, speed, and pattern (Chen 1996), or merely the frequency of these actions (Andrevski et al. 2014). As this thesis adopts a competitive dynamics view on strategy and competition, closer attention will be paid to how this research stream has addressed and defined competitive intensity. Other views on the intensity of competition were briefly reviewed at the beginning of this chapter.

In competitive dynamics, the characteristics of a firm's competitive environment are seen to affect the firm's awareness, motivation, and capability to act (Smith et al. 2001). The structure–conduct–performance view of industrial economics posits that high levels of industry growth, industry concentration, and barriers to entry each shield the firms in the industry from intense competition (Scherer and Ross 1990), and these variables have been utilized in competitive dynamics research, too, as drivers of competition in an industry (Ferrier et al. 1999; Ferrier 2001; Smith et al. 2001).

Industry growth rate is an indicator of industry demand (Schomburg et al. 1994). High demand generally leads to less intense competition than low demand since, as the market grows, competition is not a zero-sum game where new sales have to be generated through capturing rivals' customers (Miller 1990). Consequently, slow growth often leads to intensified competition and lower profitability, motivating strategic aggressiveness (Fombrun and Ginsberg 1990; Smith et al. 1992). In competitive dynamics studies, the industry growth rate has been found to have an effect on rivals' response lag, so that in high-growth industries firms respond to competitive actions more slowly than in low-growth industries (Smith et al. 1989; Schomburg et al. 1994).

Industry concentration refers to the degree to which production in an industry is dominated by a few large firms (Shughart 2008). The higher the concentration, the larger the volume of the industry's total production held by only a small number of organizations when compared to the total number of firms in the industry. A high level of industry concentration reduces the intensity of competition, as firms are less motivated to act aggressively due to the possibility of oligopolistic coordination in

the industry (Scherer and Ross 1990; Ferrier 2001). Higher levels of industry concentration seem to imply fewer competitive moves by industry incumbents (Young et al. 1996), and as the number of firms in an industry increases (lowering industry concentration), both response lag and the radicality of actions decrease (Schomburg et al. 1994). Industry concentration has been measured with a number of indexes, most commonly the Herfindahl index (sum of the squared market shares S of the n rivals), the entropy index (weighted sum of the market shares of n rivals, the weight for each share being the logarithm of the inverse of the rival i's share), and the firm concentration ratio (sum of the market shares of the m largest rivals, when $m < n$) (Porter 1980; Caves et al. 1984; Scherer and Ross 1990; Wiggins and Ruefli 2002; Giachetti and Dagnino 2014). Industry concentration has also been used as a singular measure of competitive intensity in the aforementioned studies (Porter 1980; Caves et al. 1984; Scherer and Ross 1990; Wiggins and Ruefli 2002).

Researchers have also found that barriers to entry in an industry positively influence industry performance due to competitive intensity remaining stagnant as new entrants do not increase it (Caves et al. 1984). The barriers to entry literature has proposed that industries with high levels of capital intensity, innovation, and advertising, for example, experience less competitive pressure from potential new entrants (Smith et al. 2001).

Competitive dynamics research mainly utilizes the concept of rivalry intensity in reference to competitive intensity, since rivalry is the main subject of analysis in this line of research. Rivalry is intense when the number of competitive actions between all firms in the industry is high (Young et al. 1996; Andrevski et al. 2014). Thus, when firms carry out competitive actions frequently, they compete intensely, attributing to the competitive intensity of the industry as a whole. Following this line of thought, in industries where competition is intense and the number of actions is high, the response lag is often very short, which also depicts competitive intensity (Grimm and Smith 1997). Another theoretical proxy that has been utilized for analyzing the intensity of competition in an industry is the rate of market entry and exit: a high entry rate is an indication of increased competitive intensity, similar to a high exit rate (Baum and Korn 1996).

Exploring this concept further, competitive intensity can be evaluated by the aggressiveness, speed, and pattern of competitive actions and responses in the industry (Chen 1996). According to Chen, Su, and Tsai (2007), competitive intensity denotes "the degree of pressure, threat, or tension that exists between firms." They prefer to utilize the notion of competitive tension instead, as it conceptualizes the forces that build up and eventually transform a static inter-firm relationship into a

dynamic interplay between competitors. Competitive tension can be divided into perceived competitive tension and objective structural tension, where perceived tension denotes the extent to which managers and stakeholders consider a rival to be the main competitor of the firm (Chen et al. 2007). Objective structural tension, on the other hand, refers to changing the industry structure or market conditions in the industry, and manifestations of this have been studied in the form of market commonality (Chen 1996), multimarket contact (Baum and Korn 1999), and reciprocal threat (Gimeno 1999).

This division of competitive tension into two separate concepts reveals an important consideration in the competitive intensity construct in competitive dynamics. It can be considered as either a characteristic of the industry as a whole, depicted by overall action frequency in the industry, for example, or it can be considered an attribute of the competition between the focal firm and its rival—the action–reaction dyad that is at the heart of competitive dynamics research. As such, intensity of competition can be measured between two firms or within the whole industry as a characteristic of the particular market.

In terms of multimarket contact, the mutual forbearance hypothesis (Edwards 1955) states that facing the same rival in multiple markets tempers the intensity of competition between the firms, as rivals have the opportunity to retaliate not only in the market where the initial action took place, but also in other possibly even more important markets (Baum and Korn 1996; Gimeno 1999; Smith et al. 2001). Multipoint competition has piqued ample interest as it has been seen to have a notable effect on rivalry intensity (Baum and Korn 1996; Gimeno and Woo 1996; Gimeno 1999). The typical measure of multipoint contact has been the average number of markets in which a firm operates with all its rivals in a given market, excluding the focal market in question (Chen 1996). The market commonality construct refers to "the degree of presence that a competitor manifests in the markets it overlaps with the focal firm," and as such, it better takes into account the possible differences in intensity of competition in the different markets in which the firms take part (Chen and MacMillan 1992; Chen 1996).

Competitive aggressiveness, defined as "the propensity to engage in a sustained, diverse, or unique series of actions to challenge rivals and enhance their relative competitive position" (Hughes-Morgan et al. 2018), is a concept that is highly interlinked with competitive intensity. It portrays the aggressiveness of an individual firm as reflected in its competitive volume, competitive complexity, and competitive heterogeneity (Andrevski and Ferrier 2016; Andrevski et al. 2014; Chen et al. 2007; Miller and Chen 1996b; Miller and Chen 1996a; Smith et al. 2001; Young et al. 1996;

Hughes-Morgan et al. 2018). The concept has also been used in reference to competitive intensity, action volume, and competitive action frequency (D'Aveni et al. 2010). Thus, high competitive aggressiveness among firms competing in an industry leads to increased competitive intensity in the industry.

Researchers have measured competitive intensity in a number of ways: the markup charged to consumers (Graddy 1995), relative profit difference indicators (Boone 2008), the level of barriers to entry (Caves et al. 1984; Porter 1980), the number of competitors (Porter 1980; Jeong et al. 2017), different concentration indexes (Porter 1980; Caves et al. 1984; Scherer and Ross 1990; Wiggins and Ruefli 2002), and any combination thereof (Giachetti and Dagnino 2014). Strategy researchers most commonly use the measures of number of competitors or concentration indexes (Porter 1980; Scherer and Ross 1990), since the higher the number of competitors and the lower the level of concentration, the higher the competitive intensity of the industry (Porter 1980; Giachetti and Dagnino 2014). In using these measures, researchers assume that when the number of competitors is high, the firm is more likely to be under attack, and a high level of industry concentration may lead rivals to cooperate, as large firms governing a majority of the market share in the industry are unlikely to attack each other aggressively and more likely to attempt to agree on fixed prices and quantities (Giachetti and Dagnino 2014)

Overall, industry competitive intensity is a crucial determinant of firms' competitive behavior. Besides the effects on resource availability, profitability, pricing, market positioning, and other characteristics of a firm's competitive repertoire, changes in competitive intensity have been found to significantly affect firms' product strategies, too (e.g., Giachetti and Dagnino 2014; Jeong et al. 2017; Gang et al. 2018). Increased competitive intensity may often trigger a quest for product differentiation, as firms seek to gain competitive advantage over their rivals (Porter 1980; Giachetti and Dagnino 2014). Competitive intensity also varies in different phases of an industry's evolution, and firms attempt to optimize their product lines accordingly (Jeong et al. 2017). Intensified competition might push firms to attempt to introduce better quality products than those of their competitors (Gang et al. 2018). The next sections will focus on firms' product strategies in general, because product introductions and product exits are among the competitive action types that have a significant effect on firm performance in general.

2.2 Product-market selection

A firm's product strategy plays a vital role in determining a firm's overall performance and survival in a competitive industry setting (Rumelt et al. 1991; Dowell 2006). At the heart of it are fundamental decisions pertaining to which products the firm should sell and to whom. With limited resources, managers need to carefully choose whether to allocate them to the lengthening or broadening of their product lines, or if increasing variety might in fact result in increased costs and lower profits (Lancaster 1990).

How many variations of the same product should a company offer? Henry Ford famously produced his Model T in any color "so long as it was black," taking advantage of economies of scale through assembly-line production (Sorenson 2000). Although this strategy proved highly successful at first, driving the growth of Ford Motor Company from manufacturing 10,000 cars in 1908 to 933,720 cars in 1920, it also paved the way for General Motors and their opposite strategy of "a car for every purse and purpose" (Vlaskovits 2011). Eventually, through a strategy of producing different cars for different market segments, General Motors increased its market share from 10 percent in the early 1920s to 45 percent in 1940 while Ford's share simultaneously fell from 66 percent to 15 percent (Sorenson 2000; Vlaskovits 2011). Since the time that Ford's black Model T was made available to consumers in 1908, variety has increased substantially. In 2002, consumers in the United States could choose from among 192 different car models with multiple configuration options, and in 2007, the number had risen to 234 (Moreno and Terwiesch 2017).

Using the example above from the early days of the automobile industry highlights the importance of product strategy-related decisions. However, simply increasing variety does not always lead to increased profitability; instead, it might even worsen a firm's competitiveness (Ramdas and Sawhney 2001). Nevertheless, most firms nowadays offer multiple different products to multiple different submarkets and potentially in multiple different industries. To clarify, an industry is seen to consist of various submarkets, which in turn consist of a number of product categories (also referred to as submarket niches) (Klepper and Thompson 2006; Barroso and Giarratana 2013). Together, all the products that a firm offers constitute its product portfolio. The product portfolio of a firm often consists of multiple separate product lines comprised of a number of relatively similar products with homogenous tangible characteristics that perform a similar function and are sold to the same customer section in one product category of a submarket (Kekre and Srinivasan 1990; Dowell 2006; Giachetti and Dagnino 2014).

Due to their extreme importance, firms' product portfolio strategies and variety management have long been analyzed by a wide range of research streams, from marketing (e.g., Day 1977; Boyd and Headen 1978) and new product development (Cooper et al. 1999; McNally et al. 2013) to finance (Devinney and Stewart 1988) and production and operations management (Ramdas 2003; Ramdas et al. 2003). In strategic management, however, the terminology has differed slightly from the aforementioned streams, and researchers have focused on the concept of product line strategies instead, although product portfolio has also at times been used synonymously (e.g., Kekre and Srinivasan 1990; Quelch and Kenny 1994; Bayus and Putsis 1999; Jones 2003; Bordley 2003; Dowell 2006).

In this chapter, the main focus is on the product line literature. However, as there are a number of closely related literature streams, such as diversification literature, organizational niche literature, marketing literature, and product differentiation literature, that have addressed the important considerations surrounding multiproduct firms and the decisions related to their offerings, some key findings from these will also be reviewed. The differentiation literature utilizes the concept of a related product market in the same sense that product category and product line are used in this dissertation (Zahavi and Lavie 2013), whereas the population ecology literature speaks of niches while referring to the same idea (e.g., Dobrev et al. 2001). For the sake of clarity, product line or product category will be used when reporting the results of these streams, although the authors themselves might have originally utilized different terminology.

This subchapter is divided into four parts. The first part presents an overview of the advances made in research streams closely related to product line research, namely those of product differentiation, product portfolios, diversification, population ecology, and marketing. The second part discusses product line research in more detail, focusing especially on the characteristics of a product line and the definitions of the key concepts of product line length and breadth. In the third part, contingencies and situational factors that affect the optimal length and/or breadth of a product line are reviewed. Finally, the last part examines the measurement of firm performance in previous literature and analyzes the performance implications that product line research has identified thus far.

2.2.1 Product strategies

The competitive dynamics stream of strategic management views new product introductions as a type of competitive action, which is generally categorized under

new product actions (Andrevski et al. 2016; Smith et al. 2001). The most recent research on product line strategy has focused on the effects of competitive intensity on product line length and addressed the underlying linkage between product line strategies and competitive dynamics more explicitly (see e.g., Giachetti and Dagnino 2014; Jeong et al. 2017). In this vein, actions related to product line management—such as lengthening the product line by adding new products to it or pruning it to reduce the number of products—are viewed as competitive moves that firms utilize to cope with changing competition and build and sustain a competitive advantage (Bayus and Putsis 1999; Barroso and Giarratana 2013; Jeong et al. 2017). In line with competitive dynamics research, firms act and react to competitors' actions in pursuit of market opportunities, attempting to fulfill consumer needs (Schumpeter 1942; Smith et al. 2001).

The product differentiation literature uses the concept of differentiation to describe how a firm's products are distinct from those of its competitors along both price and non-price lines (Porter 1985; Ramdas 2003). A notable difference from other views on variety is the comparison between the products of the focal firm and the products of its competitors: in other words, the differentiation aspect. Even a firm with only one product can be highly differentiated when compared to its competitors in the industry (Ramdas 2003). A differentiation strategy can be applied both horizontally and vertically (Chisholm and Norman 2012). Vertical differentiation implies offering products of different qualities, and the products may be ranked according to their objective quality at different price levels (Gal-Or 1985; Degryse 1996), whereas horizontal differentiation refers to a situation where the products cannot be ordered objectively, as no single feature is more valuable than the others (Degryse 1996). The differentiation literature does not focus on the analysis of the quantity of products in the firm's product line, but rather discusses the qualities and differences as compared to rival products.

A common consideration found in the product portfolio literature is that of diversification. The diversification literature has analyzed firms' strategic choices to diversify into new, related, or unrelated product markets and how a competitive advantage can be created through this process (Markides and Williamson 1994; Miller 2006). This literature has found that related diversifiers (i.e., firms that have knowledge that can be broadly applied in related product markets) commonly outperform single-business firms and unrelated diversifiers (Palich et al. 2000). In the related and unrelated diversification literature, the common units of analysis are product markets or industries, and analyses are made about whether a firm should enter a new industry. Thus, the level of analysis is higher than in the product line

literature, where the actions of firms are mainly analyzed within a particular industry or an industry submarket.

Within the diversification literature, however, another perspective has also gained traction: that of inter-industry and intra- or within-industry diversification. Within-industry diversification is a form of related diversification and refers to a firm being present in more than one product line (Stern and Henderson 2004) or in more than one market niche within a single industry (Li and Greenwood 2004; Tanriverdi and Lee 2008). The benefits of within-industry diversification are attributed to the resource-based view's assertion that when firms enter multiple product lines they are able to exploit the excess productive capacity of their resources (Farjoun 1994; Markides and Williamson 1994; Tanriverdi and Lee 2008). This resource relatedness enables them to benefit from economies of scope (Davis and Thomas 1993).

According to this view, low within-industry diversity limits the benefits reaped from economies of scope since resources are likely to be deployed across closely related products, offering overlapping functionality and limiting the value of these products to customers (Zahavi and Lavie 2013). If newly introduced products too closely resemble the firm's old products, the firm may encounter cannibalization and be unable to benefit from this complementarity (Cottrell and Nault 2004). Consequently, more extensive within-industry diversity offers the firm more opportunities to take advantage of resource complementarity, share resources more effectively, and increase possibilities to offer value to the customers (Jones and Hill 1988; Zahavi and Lavie 2013). Diversifying into a related product line thus enables the firm to deploy similar personnel, research and development (R&D), and marketing assets, leveraging the same technologies and thus benefiting from economies of scope (Stern and Henderson 2004; Zahavi and Lavie 2013).

The population ecology perspective has also analyzed the effects of longer product lines through niche width theory, which analyzes the effects of generalist (broad product lines) and specialist (narrow product line) strategies (Carroll 1985; Hannan and Freeman 1977). The niche width literature has addressed the survival propensity of firms with different niche width strategies by analyzing the characteristics of the organizational structure of the industry (Dobrev et al. 2001; Dobrev et al. 2003). Niche width refers to approximately the same concept as product line length, as it depicts the range of options offered by a firm in a specific product category (Dobrev et al. 2003). The theory assumes that there is a trade-off between the firm's performance capacity and its product line length (i.e., niche width) (Levins 1968). A notable difference here, however, is again the level of analysis. This

literature stream does not focus on the individual firm-level actions; rather, it analyzes the industry as a whole (e.g., Carroll et al. 1996).

In marketing, researchers have analyzed the effects of increasing product variety on consumer purchasing behavior, consumer brand perception, and economic performance, among other things (e.g., Greenleaf and Lehmann 1995; Dhar 1997; Brynjolfsson et al. 2003; Berger et al. 2007). Many have argued for a wider product assortment, since the firm is then able to respond to a wider range of customer needs, although the production costs of a product may rise (e.g., Lancaster 1990). However, it has also been argued that more options to choose from may generate uncertainty in preferences and create decision conflict, which might lead to the deferral of the purchasing decision (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992). With respect to this finding, the choice overload hypothesis states that an increased number of options to choose from may in fact have negative effects, such as a decrease in the customer's motivation to choose or less satisfaction with the chosen option (Scheibehenne et al. 2010). It has been studied extensively, as researchers in the field have increasingly acknowledged the potentially detrimental influences of an excessive product assortment (e.g., Chernev 2003; Fasolo et al. 2009; Diehl and Poynor 2010; Scheibehenne et al. 2010; Chernev et al. 2015).

2.2.2 Product line characteristics

A firm's product line strategy has a significant effect on its performance and survival, making it one of the most important strategic considerations of a firm. Despite the indisputable importance of decisions related to product line strategy, researchers have yet to reach a consensus on many of the pivotal questions surrounding the topic, starting with the nature and direction of performance effects associated with increasing product line length and/or breadth (Barroso and Giarratana 2013; Giachetti and Dagnino 2014; Jeong et al. 2017). One possible reason for this is the lack of consistent and reliable measures for both product line length and breadth, as well as for performance. Additionally, strategy researchers lack uniform definitions for length and breadth, leading to difficulties in drawing comparisons between the findings.

To address the dimensions and characteristics of a product line, a definition for a product line must first be specified. This was initially touched upon in section 1.2, but a more detailed discussion of these definitions is presented here. In this dissertation, a product line is considered *a group of products designed to perform a similar function and sold to similar customer groups in one product category* (Kekre and Srinivasan

1990; Giachetti and Dagnino 2014; Barroso and Giarratana 2013). Some researchers have also included the idea of the goods of a product line being sold through the same channels as part of the definition (Giachetti and Dagnino 2014), but as multichannel strategies have become increasingly common, web-based channels have changed the traditional channel strategies of firms, and multichannel strategies require constant maintenance, updating, and development (Berman and Thelen 2004; King et al. 2004; Rosenbloom 2007), this criterion seems a little too unambiguous and time- and situation-dependent, and thus it is not included in the product line definition used here.

Researchers have utilized a number of dimensions to analyze firms' product lines. In both the strategy and marketing literature, the most common dimensions include product line length and product line breadth, although some researchers have also addressed depth or width (e.g., Kristenson 1983; Marino and De Noble 1997; Hui 2004; Berger et al. 2007; Chisholm and Norman 2012; Barroso and Giarratana 2013). These characteristics have been addressed in relation to firms' product line strategies, where the possibilities range from increasing the breadth and/or length of a firm's product line (Giarratana and Fosfuri 2007; Barroso and Giarratana 2013) to maintaining or pruning it (Putsis and Bayus 2001).

Even though both product line length and breadth are perceived as topics of high importance and have attracted considerable attention from researchers, the question of their very definition and measurement remains open. In fact, many articles on the topic do not explicitly state what is meant by product line length or breadth, further hindering the comparison of the results in the field (e.g., Kekre and Srinivasan 1990; Boulding and Christen 2009). In addition, although many researchers do define the dimension they analyze, there are significant differences between these definitions, their dimensions, and the related measures. This chapter will address these differences and define product line length and breadth in unambiguous terms.

As the field is highly fragmented in its use of concepts, basic definitions for length and breadth are first given to enable a more informed and analytical discussion on the varying definitions presented in the literature. Thus, in this dissertation, product line length is defined as *the number of product variants in a product line* (Bayus and Putsis 1999; Putsis and Bayus 2001; Draganska and Jain 2005; Shankar 2006; Dowell 2006; Giachetti and Dagnino 2014; Jeong et al. 2017). Product line breadth, in turn, refers to *the number of product lines a firm offers in a given industry submarket* (Barroso and Giarratana 2013). These definitions are depicted in Figure 5, which presents the relationships between the central constructs of industry, submarket, product category, and product line length and breadth.

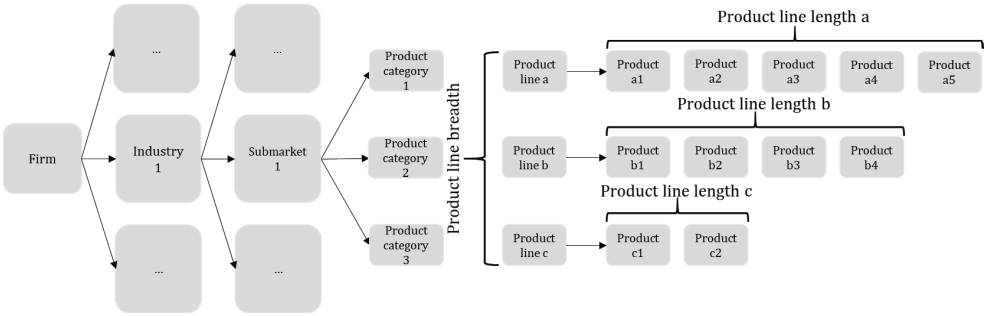


Figure 5. The definitions of product line length and breadth.

The definition for product line length adopted here is by far the most commonly used in product line strategy research, and its power lies in its simplicity and comprehensibility. Increasing the number of products in a product line increases the variety offered by a firm and thus the length of the specific product line in question. This definition was originally presented and used by Bayus and Putsis (1999), who posited that a longer product line provides a firm with the possibility of catering to a more diverse set of customer needs, thus resulting in higher market share, because the firm is able to acquire a larger and more heterogeneous customer base. A number of researchers have followed this definition and adopted the method of measuring product line length through the number of products in a firm's product line at a given moment (e.g., Jeong et al. 2017). They are listed on the first line of Table 1. However, since there is no established practice in the use of these concepts in the product line literature, a number of researchers have used length and breadth interchangeably.

Table 1. Concepts utilized in previous studies either directly or indirectly referring to the concepts of product line length and/or breadth utilized in this dissertation.

Concept used in this study	Original concept	Original manuscripts using the concept
Length	***Length***	Bayus & Putsis 1999, Putsis & Bayus 2001, Draganska & Jain 2005, Shankar 2006, Dowell 2006, Giachetti & Dagnino 2014, Jeong et al. 2017
	Breadth	Robinson & Fornell 1985, Kekre & Srinivasan 1990, Bayus & Putsis 1999, Sorenson 2000, Bordley 2003, Shankar 2006, Boulding & Christen 2009, Chisholm & Norman 2012, Moreno & Terwiesch 2017
	Depth	Berger et al. 2007, Eggers 2012, Barroso & Giarratana 2013
	Width	Hui 2004
	Variety	Sorenson 2000, Berger et al. 2007
	Extension	Quelch & Kenny 1994, Kadiyali et al. 1999, Axarloglou 2008
	Proliferation	Bayus & Putsis 1999, Barnett & Freeman 2001
	Versioning	Giarratana & Fosfuri 2007, Barroso & Giarratana 2013
	Within-niche proliferation	Barroso & Giarratana 2013
Breadth	***Breadth***	Berger et al. 2007, Eggers 2012, Barroso & Giarratana 2013
	Depth	Marino & De Noble 1997
	Complexity and length	Dowell 2006
	Portfolio broadening	Giarratana & Fosfuri 2007
	Across-niche proliferation	Barroso & Giarratana 2013
	Variegation	Ramdas 2003, Barroso & Giarratana 2013
	Intraindustry diversification	Zahavi & Lavie 2013, Barroso & Giarratana 2013

There is also a line of research that has mainly utilized product line breadth to describe the same idea of the number of product variants in a firm's product line, which is referred to here as length (Robinson and Fornell 1985; Kekre and Srinivasan 1990; Sorenson 2000; Bordley 2003; Boulding and Christen 2009; Chisholm and Norman 2012; Moreno and Terwiesch 2017). Additionally, the same notion has also been conveyed through the concepts of product line depth (Berger et al. 2007; Eggers 2012; Barroso and Giarratana 2013), width (Hui 2004), and variety (Sorenson 2000; Berger et al. 2007). The difficulty in interpreting the definitions lies in the previously mentioned remark that many studies on product line characteristics do not explicitly state what is meant by the length or breadth of the product line, resulting in the ambiguity that currently surrounds these concepts. In this far from ideal situation, a reader is often forced to draw their own conclusions on the specific meanings of length, breadth, width, or depth that the authors are attempting to convey. Thus, in Table 1, these types of interpretations have been made based on the explicit or implicit descriptions the authors have provided in their articles.

The first section of Table 1 lists some of the relevant concepts used in product line management literature in the same sense as the notion of product line length adopted in this dissertation. The first five concepts introduced illustrate the entity

and extent of a firm's product line, whereas the latter four notions are more related to action—they portray the act of increasing the variety of a firm's product line. Product line extension refers to introducing a new product that is a variation of an existing product (Quelch and Kenny 1994; Kadiyali et al. 1998; Axarloglou 2008). Whereas some articles discuss product proliferation, the exponential increase in product variants in a product line (Bayus and Putsis 1999; Barnett and Freeman 2001), others describe it as versioning (Giarratana and Fosfuri 2007; Barroso and Giarratana 2013), and some others discuss within-niche proliferation (Barroso and Giarratana 2013). Despite the variance in the use of concepts, all of the authors seem to refer to basically the same concept of increasing the length of the product line. The majority of these studies also use the number of products in a firm's product line as the main measure of product line length (e.g., Bayus and Putsis 1999; Draganska and Jain 2005; Dowell 2006; Jeong et al. 2017).

There is even more confusion related to product line breadth since, as noted above, breadth has commonly been used in reference to what has here been termed as length. However, researchers have also distinguished between the two notions in somewhat differing ways. Dowell (2006) views breadth as comprising both the product line length of a firm and the complexity of its product lines. Through complexity, he attempts to capture the extent to which the firm's product lines draw from different knowledge bases (Podolny et al. 1996) and are directed at different market segments (Delacroix and Swaminathan 1991; Dowell 2006).

Barroso and Giarratana (2013) present another interesting distinction: they distinguish between within-niche product proliferation (length) and across-niche product proliferation (breadth). According to their definition, within-niche proliferation implies increasing the number of product variants to sell in one product category, and across-niche proliferation implies that the firm increases the number of product categories in which it sells its products (Barroso and Giarratana 2013). The definition of product line breadth utilized in this dissertation is derived from this notion. Breadth implies catering to a broad set of different product categories (i.e., customer segments and submarket niches) within the industry submarket, whereas length implies catering to a wide variety of slightly differing customer needs within the same product category through increasing the length of the product line offered for that particular customer segment that forms the product category.

Additionally, a few other researchers also utilize the concept of breadth in the same sense, although some deciphering is needed to ascertain this, as the researchers do not explicitly define breadth in their studies (Berger et al. 2007; Eggers 2012). In the same vein, the notion of possessing multiple product lines catering to the needs

of diverse customer segments has been portrayed through depth (Marino and De Noble 1997), portfolio broadening (Giarratana and Fosfuri 2007), variegation (Ramdas 2003; Barroso and Giarratana 2013), and intra-industry diversification (Zahavi and Lavie 2013; Barroso and Giarratana 2013).

In terms of modifying the length and breadth of their product lines, there are a number of product line strategies that firms can utilize. These include lengthening or broadening their product lines, maintaining their current product lines and promoting and distributing them more effectively, shortening or narrowing down their product lines to focus their operations in order to find new opportunities, or exiting the market (Lancaster 1990; Boone 2000; Putsis and Bayus 2001; Draganska and Jain 2005; Dowell 2006; Shankar 2006; Giachetti and Dagnino 2014). The next section will analyze the environmental, competitor, and firm-related factors that affect firms' decisions on which product line strategies to use.

2.2.3 Determinants of product line decisions

There are a number of situational factors that play a role in determining the most profitable length and breadth of a product line at a given time. In addition to the overall competitive environment of the industry, the characteristics of the firm itself and its competitors also need to be considered when making product line-related decisions. Under certain conditions, the decision to considerably lengthen the firm's product line might prove to be a very profitable one, whereas in a different competitive environment the effect might be completely different (e.g., Gang et al. 2018). In the literature on product line management, two distinct research streams can be distinguished: studies focusing on the determinants of product line decisions and studies analyzing the impact of product line decisions on firm performance (Jeong et al. 2017). The following sections will focus on these topics and present an overview of the current status of the research on both streams, starting with the factors that require consideration when selecting product line strategies.

In operations management, there is a large body of research attempting to identify the optimal product line length of a firm under certain conditions through the use of mathematical optimization models, considering especially the quality and price attributes of the products (e.g., Lal and Matutes 1994; Chen and Hausman 2000; Matsubayashi et al. 2009). In strategic management, however, research has focused more on identifying the factors that possibly affect the optimal product line decision (and thus need to be considered in product line decision-making) and analyzing the direction of their impact (Giarratana and Fosfuri 2007; Giachetti and Dagnino 2014).

Researchers have analyzed dozens of varying factors, ranging from barriers to entry (Brander and Eaton 1984; Schmalensee 1978), market structure (Shugan 1989), heterogeneity of customer needs (Bayus and Putsis 1999), and industry competitive intensity (Giachetti and Dagnino 2014) to firm age (Giarratana and Fosfuri 2007) and product price (Kekre and Srinivasan 1990). Among this diverse set of determinants, three sets of commonly considered factors emerge on the industry level, firm level, and product level. This division is based on attributes of the factors presented in the product line literature.

Industry-level determinants are those market environment conditions that are mainly dependent on certain pre-existing structures of the industry and/or the actions of the stakeholders of the focal firm, such as its rivals, customers, and suppliers. Thus, the capability of the focal firm to influence these conditions is limited, and the conditions portray attributes that are not related to only the focal firm, but instead depict those of another actor or a set of actors in the industry. Firm-level factors, on the other hand, are those that are inherently related to the focal firm and portray some attributes or qualities of the firm itself or its actions in the industry. Product-level factors are related to the qualities of the products sold by the focal firm and are thus attributes that the focal firm itself can influence. Some of the most commonly analyzed factors on all three levels are presented in Table 2.

Table 2. Commonly cited factors affecting product line decision-making.

	Schmalensee 1978	Brander & Eaton 1984	Robinson & Fornell 1985	Shugan 1989	Kekre & Srinivasan 1990	Quelch & Kenny 1994	Bayus & Putsis 1999	Sorenson 2000	Putsis & Bayus 2001	Barnett & Freeman 2001	Jones 2003	Dowell 2006	Giarratana & Fosfuri 2007	Boulding & Christen 2009	Barroso & Giarratana 2013	Giachetti & Dagnino 2014	Jeong et al. 2017	Moreno & Terwiesch 2017	Gang et al. 2018
Industry factors																			
Industry concentration							x		x										
Industry density (firms)			x					x				x	x		x		x		
Industry density (products)							x	x		x					x				
Competitive intensity						x								x		x	x		
Entry barriers	x	x												x					
Industry growth rate							x		x					x					
PLL of rivals/market leader																x	x		x
Heterogeneity of customer needs							x												
Industry life-cycle phase																	x		
Firm factors																			
Firm age							x	x	x	x			x	x		x	x		
Firm size										x		x	x		x	x			
Entry order			x					x			x		x	x					
De novo/de alio											x	x					x		x
Product factors																			
Product price			x		x		x	x	x										
Product quality/tech. capability			x	x										x			x		x
Manufacturing costs				x	x													x	

Industry-level determinants

In line with the competitive dynamics literature, an industry's competitive environment plays an important role in shaping firms' product line strategies (Sorenson 2000; Giachetti and Dagnino 2014). The product line literature has included a number of factors to take these effects into account. Market structure characteristics, such as industry concentration, industry density (in terms of both firms and products), competitive intensity, industry growth rate, and barriers to entry, have frequently been viewed as important determinants of product line decisions and their success or failure (Robinson and Fornell 1985; Bayus and Putsis 1999; Barnett and Freeman 2001; Schmalensee 1978; Boulding and Christen 2009; Giachetti and Dagnino 2014; Jeong et al. 2017).

Industry concentration and industry density are both important determinants of competitive intensity (Porter 1980). Industry concentration has been measured using the Herfindahl index (HHI), formulated as

$HHI = \sum_{i=1}^{n}(\Pi_i)^2$, where

Π_i = the market share of firm *i,* and *n* = the number of firms in the industry.

HHI thus portrays the magnitude of concentration in the industry in question, in other words, whether a large portion of the industry is controlled by a few companies in terms of market share (Rhoades 1993). The use of the HHI in product line studies has been justified based on the notion that it captures the effects of market power and industrywide coordinated behavior (Bayus and Putsis 1999). Firms have been found to be more likely to expand their product lines under conditions of low industry concentration (Putsis and Bayus 2001).

In terms of industry firm density, several product line researchers have drawn from the population ecology perspective (Carroll 1985; Carroll and Hannan 1989) and analyzed industry firm density as a factor depicting industry structure (e.g., Sorenson 2000; Giarratana and Fosfuri 2007). In line with the population ecology literature (Carroll et al. 1996; Dobrev et al. 2002), industry firm density has been seen to decrease firms' chances of survival (Dowell 2006; Giarratana and Fosfuri 2007).

A number of studies have also considered industry density through product density (i.e., the total number of a firm's competitors' products on the market) (Sorenson 2000). In terms of its effects, the results have been mixed: some have found a negative effect on market share (Bayus and Putsis 1999), some a positive one on survival rates (Sorenson 2000), and others have found no significant effect at all (Barnett and Freeman 2001; Barroso and Giarratana 2013). The negative performance effect has been argued to be a result of overcrowding in the product space, which limits the possibilities of firms to gain market share (Bayus and Putsis 1999), whereas the positive effect has been backed by the proposition of an expanding product space offering more variety to customers and increasing the carrying capacity of the segment, thereby enabling the survival of a larger number of firms (Sorenson 2000). Another possible explanation is the notion that multiproduct firms generate weaker competition than single-product firms because they are forced to divide their resources among a wider set of products, thus engaging fewer resources in the development of a single product (Sorenson 2000).

In more recent advances in the product line literature, especially, the competitive intensity of an industry has received more attention (Boulding and Christen 2009; Giachetti and Dagnino 2014; Jeong et al. 2017). The measure utilized by Boulding and Christen (2009) attempts to capture both the degree of entry barriers and the degree of competitive rivalry (Porter 1980) into a single measure of competitive intensity based on the profit impact of marketing strategies database (Boulding and Staelin 1995; Boulding and Christen 2009). Two more recent studies, however, have

taken a competitive dynamics view on the topic and examined the product line strategies firms use to cope with changes in the competitive intensity of the industry (Giachetti and Dagnino 2014; Jeong et al. 2017). In these studies, firms' product line strategies have been considered as competitive moves that firms use to defend their market share and profits and react to changes in the competitive environment (Jeong et al. 2017). As competitive intensity increases, firms attempt to defend their position in the market to protect their invested resources because they have invested resources into it (Ferrier et al. 2002). Incumbents might do this through the lengthening of their product line, as a wider variety of products can prevent their customers from switching to those of their rivals (Klemperer 1995). Under very high levels of competitive intensity, product line lengthening might not be the best strategy, as it presents firms with coordination and decision-making speed challenges (Jones 2003), and the capability to flexibly and rapidly respond to the competitive actions of rivals is extremely important under those circumstances (Draganska and Jain 2005).

Both of the studies analyzing the relationship between competitive intensity and product line length find an inverted U-shaped relationship (Giachetti and Dagnino 2014; Jeong et al. 2017), and a higher survival rate is found for firms that follow a product line strategy of adjusting to changes in competitive intensity (Jeong et al. 2017). Giachetti and Dagnino (2014) construct a composite measure that assumes that the competitive intensity of the industry increases as the number of firms in the industry increase and as the concentration level drops. Jeong et al. (2017) utilize the number of firms in the market and its natural logarithm. The measurement of competitive intensity was discussed in more detail in the previous section.

As noted earlier, barriers to entry are highly interlinked with other structural factors of an industry (Porter 1980). Similarly, the industry growth rate has been considered an important factor affecting the product line strategies of firms (Bayus and Putsis 1999; Putsis and Bayus 2001; Boulding and Christen 2009). The basic assumption behind the studies on entry barriers is that longer product lines that lead to increased variety in the industry increase entry deterrence as crowding of the product space makes it less appealing to new entrants (Schmalensee 1978; Brander and Eaton 1984; Boulding and Christen 2009). However, one study found this to be true for consumer goods but not for industrial goods industries (Boulding and Christen 2009). The effect of market growth rate, on the other hand, is based on the notion that a high market growth rate acts as an incentive for firms to introduce new products and lengthen their product lines to satisfy various customer needs in the

growing customer segments (Lancaster 1990; Quelch and Kenny 1994; Bayus and Putsis 1999).

Stages in the industry lifecycle have been considered in a few recent studies on product strategies (Jeong et al. 2017; Gang et al. 2018). The evolution of an industry typically follows the same path from birth to maturity: at first, the number of firms in an industry grows slowly, after which it experiences a sharp increase before reaching a peak. Subsequently, a shakeout occurs, and the number of firms in the industry declines heavily, and a few larger firms end up dominating the industry (Agarwal et al. 2002). Before the shakeout, competition is commonly based on product improvements, whereas the period after it is characterized by more standardized products, less variety, and process improvements that drive down the price of the products (Peltoniemi 2011). The number of firms in the industry may be the same both before and after the shakeout, and for this reason it is important to distinguish between these periods, especially when using other measures that might take the same value in both phases, such as industry firm density as a proxy for competitive intensity (Jeong et al. 2017; Gang et al. 2018).

Firm-level determinants

Among the firm-level factors, firm age, firm size, the order of entry into an industry, and whether the firm has pre-existing experience in the industry and the core capabilities required to compete in it have been some of the most commonly analyzed attributes. The firm age variable in Table 2 comprises two different takes on age: tenure in an industry and firm age calculated since its founding. Some studies have analyzed the tenure of firms in an industry (e.g., Jeong et al. 2017), others have focused on the total age of the firm (Bayus and Putsis 1999), and many have taken into account both variables (Sorenson 2000; Giarratana and Fosfuri 2007). The tenure in industry variable is often used to capture the firm's experience in the market, and its inclusion in studies is grounded on the notion that firms with more experience in the industry in question tend to be more likely to survive due to the learning effect, for example (Scherer and Ross 1990; Bayus and Putsis 1999). The entry order variable is often designed to capture similar effects of whether firms benefit from entering the industry early and whether their product strategies differ accordingly (Giachetti and Dagnino 2014).

Firm age calculated from the firm's founding and whether the firm has entered the industry as either a *de novo* or *de alio* actor are also interlinked variables, as they are often used to control for pre-entry experience, which might benefit a firm in

comparison to a newly established firm (Sorenson 2000), since the more established firm has had time to acquire capabilities that it can exploit in the new industry (Jones 2003).

Product-level determinants

Among the product-level factors, product price, the quality or overall technological capability of the products, and manufacturing costs were included in many analyses. In terms of price and manufacturing costs, longer product lines tend to raise prices because manufacturing costs increase due to coordination difficulties (Kekre and Srinivasan 1990; Bayus and Putsis 1999). However, firms may restrain the potential negative cost effects through the adoption of manufacturing strategies, such as differentiating the product while maintaining a high number of common parts (Hayes et al. 1988) or differentiating the product at a later stage of the manufacturing process (Kekre and Srinivasan 1990). The price variable has also been used to identify different segments (i.e., high-end and low-end) in the industry (Sorenson 2000).

Product quality, which in technology industries is often viewed through the lens of the technological performance of the firm's products, is also an important consideration (Robinson and Fornell 1985; Jeong et al. 2017). The impact of product quality on product sales is considerable, and it may differ in the early stages of the industry's evolution when compared to the later periods (Agarwal and Bayus 2002). Quality-based competition often prevails in the early stages of industry evolution, but cost-based competition is more intense later on (Klepper 1997; Agarwal and Bayus 2002), which also has important implications for firms' product lines. Researchers have posited that it is often easier for firms to focus their resources on developing higher-performing products when their product lines are shorter and they are not required to divide their limited development resources between a wide set of products (Jeong et al. 2017).

In addition, especially within technology-intensive industries, there are often particular product attributes that define and shape the criteria by which customers evaluate and rate the products. Those are the attributes that form the basis of competition in an industry (Christensen 1997). Thus, the technological performance of a product can often be measured through certain quantifiable variables, such as printing speed in the printer industry (Gang et al. 2018). This acts as an objective valuation of product quality, whereas product quality may also be analyzed through

customer-perceived quality, which does not pertain to a particular attribute and often resembles more an attitude or a judgment made by the customer (Zeithaml 1988).

2.2.4 Performance implications of product line decisions

A pivotal question posed in the product line literature has long been the performance effects of longer or broader product lines. Are they in fact worth pursuing, and if so, under what circumstances? A number of different performance measures have been used to analyze the relationship between a firm's choice of product line strategies and its performance, and the debate on the direction of the performance effects of longer, shorter, broader, or narrower product lines has been ongoing in the literature (Quelch and Kenny 1994; Giachetti and Dagnino 2014). Besides multiple product line measures and a wide variety of determinants of product line decisions, academics have utilized an array of firm performance measures, too. These range from sales growth (Cardozo et al. 1993; Bayus and Putsis 1999), profit (Bordley 2003; Barroso and Giarratana 2013), and market share (Kekre and Srinivasan 1990; Bayus and Putsis 1999; Moreno and Terwiesch 2017) to survival (Sorenson 2000; Barnett and Freeman 2001; Dowell 2006). In addition to posing a generalizability problem, there are problems related to each of the most used performance measures of profit, market share, and survival (Lieberman and Montgomery 2013). The measurement of firm performance is next discussed in more detail, before moving on to address the key findings of product line strategy researchers on performance in the latter part of this chapter.

Measurement of performance in product line research

Firm performance is the true time test and measure of any strategy (Schendel and Hofer 1979) and has thus been an integral variable of interest in strategic management studies (Venkatraman and Ramanujam 1986). However, as the topic is highly relevant for research, there has been much discussion and disagreement over the criteria and indicators of performance (Dalton et al. 1980; Ford and Schellenberg 1982; Chenhall and Langfield-Smith 2007; Richard et al. 2009). A wide variety of measures have been used and many have been found inadequate and lacking for the measurement of the construct, at least as separate indicators (Murphy et al. 1996; Carton 2004; Carton and Hofer 2010).

The concept of firm performance has been discussed through hierarchical constructs that capture different aspects of performance (Venkatraman and

Ramanujam 1986). Financial performance measures are used to define a firm's overall effectiveness, whereas operational performance measures (i.e., nonfinancial), the likes of product quality and market share, offer a broader view on firm performance as variables that attempt to capture factors leading to financial performance (Kaplan 1983; Chakravarthy 1986; Hofer and Sandberg 1987). In strategic and entrepreneurship research, common performance measures have been related to efficiency, growth, profit, size, liquidity, success or failure, and market share (Murphy et al. 1996). Efficiency-related measures include, for example, return on investment, return on equity, and return on assets. Growth-related measures include, for example, changes in sales, changes in the number of employees, changes in net income margins, and market share growth. Profit-related measures include return on sales, net profit margins, and gross profit margins. Size- and liquidity-related measures include sales levels, cash flow levels, current ratios, and quick ratios. Success or failure measures have been based on researchers' or respondents' subjective assessments or discontinued business, whereas market share has been based on an evaluation of the respondent or a calculation of firm product sales to industry product sales (Murphy et al. 1996).

Many of the financial measures of performance have been criticized for their validity in measuring firm performance (Carton and Hofer 2010). Studies testing multiple financial performance measures have yielded significantly different results when comparing each of the independent variables with a different dependent variable of financial performance (Robinson 1999), and in one study, 32 of 40 measures tested were identified to discriminate between high- and low-performing firms (Carton 2004). The conclusion has even been drawn that the relationship between a given independent variable and performance is in fact quite likely to depend on the particular performance measure used in the study (Murphy et al. 1996). Consequently, the generalizability of the findings is often very low.

In evaluating firm performance measures, researchers have distinguished between hard (i.e., sales, gross profit, etc.) and soft (self-perceptions and assessments etc.) measures (Dalton et al. 1980). The problem with many of the hard measures is their poor availability for non-public firms and the fact that in terms of profit, for example, some firms might still be viewed as successful although they are not currently making any profit (Lieberman and Montgomery 2013). In addition to profit, market share and survival have been the most used performance measures in product line research, and thus they are reviewed next in greater detail.

Although commonly used, there are shortcomings to using survival as a performance measure, too. Survival in an industry does not necessarily reflect firm

performance, since companies may survive for long periods of time even if their profits are meagre at best (Mitchell 1991). Moreover, survival is not the aim of all companies. In fact, many startups aim to be acquired at a good price, measuring their performance by the size of the offer they get from a bigger firm. There are also a number of ways to exit the market, from mergers and acquisitions to shifting the business focus (Lieberman and Montgomery 2013).

As a variable, market share value depends critically on market definition. In addition, it does not adequately acknowledge firms following niche strategies that do not even attempt to gain a dominant market share in the market as a whole (Lieberman and Montgomery 2013). Consequently, the problem is that information is often not available so that each researcher might use the same performance measures, and, as noted here, a universally good measure does not exist.

Thus, based on the prior brief review of the problems concerning firm performance measurement in strategic management research, new perspectives from related fields are welcome (Chenhall and Langfield-Smith 2007). As one of the benefits that firms seek to reap through increasing the length of their product lines is better and more accurate fulfillment of customer requirements, there is reason to consider a performance measure that is more directly linked to the performance of the firm's products in the market and in the eyes of customers. The success and performance of a product and the firm itself is highly dependent on the firm's capability to satisfy the customer by meeting their needs and expectations (Churchill et al. 1982; Anderson et al. 1994; Herrmann et al. 2000). These expectations play a major role in customer satisfaction through disconfirmation, which is the extent to which the perceived quality of the product fails to match the customer's prepurchase expectations (Szymanski and Henard 2001; Anderson and Sullivan 1993).

Prepurchase expectations are, in turn, increasingly shaped by information acquired online, since nowadays it is very common for customers to seek knowledge on the quality of new products before purchasing them (Clemons and Gao 2008; Zhu and Zhang 2010; Clemons 2008). Empirical research seems to support the idea that online consumer reviews significantly influence customers' purchasing decisions, and consequently affect product sales as a whole (Godes and Mayzlin 2004; Liu 2006; Dellarocas et al. 2007). The change is notable from how customers previously evaluated products before making a purchase. Only a few decades ago, products and services were most often acquired based on an evaluation of extrinsic cues, such as brand name, price, and packaging (Zeithaml 1988). The use of intrinsic cues (e.g., physical product differences) was often not possible, as it required a lot of time and effort to obtain and was not available at the time of purchase (Selnes 1993).

Online customer reviews, however, have made it possible for customers to acquire intrinsic cues and with relatively little effort. The power of word of mouth has increased manifold, as it is now available to customers online (Dellarocas et al. 2004).

Customers increasingly utilize online reviews as a valuable source of information on products (Archak et al. 2011), and there is reliable and consistent evidence of their effect on product purchase decisions and product sales (Dellarocas et al. 2004; Park et al. 2007; Lin et al. 2011). However, empirical research suggests that a product's quality is not accurately reflected in online consumer reviews (Hu et al. 2006; Koh and Hu 2010), and more recent research has argued that online customer reviews are in fact a representative measure of customer satisfaction, rather than of the product's true quality (Engler et al. 2015). The use of customer evaluations as a firm performance measure has been attributed to its link with satisfaction. The success and performance of a product is highly dependent on its capability to satisfy the customer by meeting their needs and expectations (Churchill et al. 1982; Anderson et al. 1994; Herrmann et al. 2000), and customer satisfaction is thus strongly linked with firm performance (e.g., Anderson et al. 1994; Fornell et al. 1996; Anderson et al. 1997; Williams and Naumann 2011).

Performance implications of product line strategies

Despite the problems with performance measures, some interesting advances have still been made in the product line literature. Recently, researchers have begun to consider a wider range of time-variant and time-invariant controls and become aware of the multiple contingencies that need to be taken into account in order to attain the most reliable results possible. As the previous section on product line determinants demonstrated, firms' product line strategies are dependent on a number of factors that themselves experience constant changes and depend on a variety of other attributes.

In addition to analyzing the performance effects of product line actions with somewhat mixed results, current research has identified a number of possible advantages and disadvantages related to extending the length and/or breadth of a firm's product line that ultimately influence the product line length/breadth firm performance relationship. The benefits associated with extending a firm's product line range from sustaining customer loyalty (Klemperer 1995), raising entry barriers (Bordley 2003), and increasing economies of scope (Zahavi and Lavie 2013) to increased market share and the opportunity to charge higher prices for products that meet customer needs more accurately (Kekre and Srinivasan 1990). Conversely, the

possible drawbacks include cannibalizing the firm's own products (Axarloglou 2008), manufacturing process disruptions and higher unit costs (Hayes and Wheelwright 1984), higher inventory costs (Bayus and Putsis 1999), diseconomies of scale (Putsis 1997), higher distribution and marketing costs (Aaker and Joachimsthaler 2000), management and coordination difficulties (Quelch and Kenny 1994), and a greater degree of product overlap, resulting in intensified competition (Hannan and Freeman 1977; Dowell 2006).

Still, despite all other possible benefits and pitfalls associated with product line strategies, their effects on firms' overall performance is a question that interests academics and practitioners alike, and it is one that researchers have been unable to answer comprehensively. Table 3 presents some of the findings of research articles on product line strategies and their performance effects. The articles were selected based on their use of one of the three most common performance measures in product line literature (profit, survival, and market share) to enable a comparison of the results. A general observation can be made that the results are somewhat contradictory. A number of studies argue there is a positive relationship between longer product lines and firm performance (e.g., Robinson and Fornell 1985; Barnett and Freeman 2001; Moreno and Terwiesch 2017), some have found a negative one (e.g., Quelch and Kenny 1994; Boulding and Christen 2009), and still many others find the relationship to be conditioned by some of the previously mentioned determinants and actually form an inverted U-shaped relationship (Sorenson 2000; Giarratana and Fosfuri 2007; Barroso and Giarratana 2013; Jeong et al. 2017; Gang et al. 2018). In terms of increased product line breadth, research has found positive (Giarratana and Fosfuri 2007) and U-shaped (Dowell 2006; Barroso and Giarratana 2013) relationships. The following sections first address the performance effects of longer product lines according to researchers in the product line research stream, then they discuss the wider scope of performance effects from other highly related streams and similarly analyze the effects of broader product lines and the effects found on related research streams.

Table 3. The performance measures commonly utilized in product line research and the findings on the effects of increasing product line length or breadth.

	Robinson & Fornell 1985	Kekre & Srinivasan 1990	Bayus & Putsis 1999	Sorenson 2000	Putsis & Bayus 2001	Barnett & Freeman 2001	Dowell 2006	Giarratana & Fosfuri 2007	Boulding & Christen 2009	Barroso & Giarratana 2013	Jeong et al. 2017	Moreno & Terwiesch 2017	Gang et al. 2018	Dowell 2006	Giarratana & Fosfuri 2007	Barroso & Giarratana 2013
Performance measures	L	L	L	L	L	L	L	L	L	L	L	L	L	B	B	B
Market share	+	+	+		+							+				
Survival				I		+	+	I			I		I	U	+	
Profit		+							-	I						U

Notation:
+ *increasing length or breadth* ***increases*** *firm performance*
- *increasing length or breadth* ***decreases*** *firm performance*
I *inverted U-shaped relationship*
U *U-shaped relationship*
L *the study analyzes the effects of product line length*
B *the study analyzes the effects of product line breadth*

Positive effects

The older studies on the topic especially found a mainly positive, linear relationship between increasing product line length and firm performance, and many of them used market share as the dependent variable in their analyses (Robinson and Fornell 1985; Kekre and Srinivasan 1990; Bayus and Putsis 1999). However, although often reported as supporting product line extensions, since they find a positive relationship between market share and product line length, Bayus and Putsis's (1999) seminal work actually paints a more versatile picture. Based on their results, there are incentives for both lengthening and shortening the product line. Longer product lines are linked with higher demand and are also associated with higher costs and thus higher prices, which both encourage further lengthening of product lines. On the other hand, the higher prices resulting from increased costs lead to lower demand and the higher market share that results from longer product lines is also associated with lower prices, both of which act as a demotivation to further expand the product line (Bayus and Putsis 1999).

A recent take on the market share–product line length relationship interpreted the positive result as derived not from the market share increase by the newly introduced products, but instead from the increased possibility for the customers to

find a product suitable for their needs from the longer product line (Moreno and Terwiesch 2017). Another potential explanation offered has been the attainment of economies of scope through longer product lines, resulting in increased market share and profit (Bailey and Friedlaender 1982; Kekre and Srinivasan 1990). The positive effect on both market share and profit is to be expected, as it is supported by studies analyzing the relationship between the two factors that have found that increased market share often results in an increase in profits (Phillips et al. 1983; Jacobson and Aaker 1985; Kekre and Srinivasan 1990).

A number of studies have analyzed the effects of product line length through survival analyses (e.g., Sorenson 2000; Barnett and Freeman 2001; Dowell 2006). Barnett and Freeman (2001) find that longer product lines with especially innovative products lower firm mortality rates; but, conversely, if multiple new products are introduced simultaneously, the exit hazard grows substantially. Thus, a strategy of gradually and incrementally lengthening the product line seems to yield the best results (Barnett and Freeman 2001). Another study also found the same positive effect on survival, but noted that the effect seemed to hold specifically for firms entering the center of the industry (i.e., those firms that enter in the segment with the most sales in the industry), as the study also simultaneously considered breadth (Dowell 2006).

In other related research streams, researchers have argued that introducing new products to an existing product line in a segment in which it has prior knowledge benefits the firm through learning-by-doing effects in increased management and operational efficiency (Kim and Kogut 1996; Kogut and Zander 1992; Smith et al. 2005). Consequently, the quality of the new products introduced increases (Eggers 2012). The continuous refinement of products in the line through the introduction of new versions helps firms to better and more precisely meet the heterogeneous needs of customers and signal responsiveness to them (Shapiro and Varian 1998; Kotler and Keller 2015). This view is supported by the population ecology perspective, which asserts that a specialist strategy of focusing on a particular niche increases firm identity and bonds with the customers in the niche, thereby increasing the firm's chances of survival (Hsu et al. 2009). Long product lines can benefit the firm, especially in the early stages after entering the industry, as they enable the firm to probe the market and make incremental changes to their products in order to meet customer needs without major operational changes or a wide variety of resources (Chong et al. 1998; Dowell 2006).

Negative effects

An entirely negative relationship between increased length and performance has not been a common finding in the studies, which further supports the popularity of product line lengthening strategies. In their well-known article, Quelch and Kenny (1994) advocate for more deliberation on product line extension decisions and point out a number of potential pitfalls. They state that product line extensions often result in lower brand loyalty, as previously loyal customers are prompted to seek increased variety elsewhere since they encounter it in their preferred brand, too. In addition, line extensions may result in increased costs because production and logistics complexity increase, for example.

Although Boulding and Christen (2009) have found a positive relationship between product line length and market demand, they also argue that increased product line length has a negative effect on firm profits for market pioneers. In their view, this is due to higher organizational and operational complexity resulting from increased variety in the product line, which increases average costs (Anderson 1995; Boulding and Christen 2009). The costs rise as a result of diseconomies of scale (i.e., higher average production costs per product) and uncertainty about heterogeneous customer needs, which causes higher marketing costs through market research, inventory, product markdown, and lost sales (Randall and Ulrich 2001).

Researchers have identified cannibalization as an especially prominent threat to a product line lengthening strategy in both product line literature and related literature (Garud and Kumaraswamy 1993; Hui 2004; Axarloglou 2008; Barroso and Giarratana 2013). Cannibalization refers to a situation where a pre-existing product's sales or market share is reduced as a consequence of the firm introducing a new product (Wilson and Norton 1989; Moorthy and Png 1992), possibly compromising the customer-perceived identity of the firm and its products (Garud and Kumaraswamy 1993; Barroso and Giarratana 2013). Longer product lines might also result in shorter product life spans and even impede the firm in recouping its product innovation investments (Garud and Kumaraswamy 1993). Extending the firm's product line can also cause difficulties in within-organization learning in terms of fully reaping the benefits of new product introductions (Stern and Henderson 2004). Rising control and coordination costs are also commonly cited problems (Jones and Hill 1988).

Non-linear relationships

As can already be noted from the results addressed above, many of the performance effects attributed to product line length are not straightforward or simple, but instead they are conditional on at least one—if not a number of—environmental attributes and other firm- and product-level factors. No researcher has been able to credit a universally positive effect of lengthening the product line with firm performance. Nonetheless, a number of situations in which increasing the length of the product line might be a beneficial strategy have been found. In the past decade especially, studies have increasingly incorporated a more diverse set of variables into their analyses, and this has resulted in an increase in the number of results where the effects of lengthening the product line change from positive to negative under certain circumstances (e.g., Giarratana and Fosfuri 2007; Barroso and Giarratana 2013; Jeong et al. 2017).

Sorenson (2000), for example, has found that in an environment of low product density, survival rates are higher for those firms that maintain longer product lines; but as product density increases, culling the product line becomes a more advantageous strategy. He compresses his main finding into a guideline for managers: *"When everyone else expands their product lines, you should think about culling yours."* The results of the study also indicate that product line culling is not an efficient strategy when customer needs are uncertain, since a greater degree of variety will probably better meet their needs (Sorenson 2000). Another potential upside of a longer product line is the possibility of managers hedging their bets in terms of the degree to which their product line aligns with diverse and dynamic consumer preferences. This is due to firms with longer product lines being able to afford to have some of their products fail, whereas firms with shorter product lines have more at stake regarding the success of each product they offer (Sorenson 2000).

In another study, Giarratana and Fosfuri (2007) have found that for a focused firm, lengthening the product line is a beneficial strategy for increasing the firm's survival chances, but if the breadth of the product line increases, lengthening becomes an unfavorable strategy. They propose that this is due to learning effects and Red Queen competition (van Valen 1973; Barnett and Sorenson 2002; Derfus et al. 2008). Red Queen competition refers to a situation where competition is self-reinforcing, as it triggers internal learning in the organization aimed at exploring new alternatives, which in turn leads to decreased competitor performance and forces the competitors to react through their own learning and innovation process (Barnett and

Sorenson 2002; Derfus et al. 2008). Consequently, competition constantly intensifies (Derfus et al. 2008).

Barroso and Giarratana (2013) find that there is an inverted U-shaped relationship between product line length and performance. They state that up until a certain threshold level, increasing product line length increases firm performance, but after the threshold, cannibalization costs start to take effect, decreasing performance. In Barroso and Giarratana's (2013) study, the relationship between product line length and performance is steepened by product space complexity, a function of the heterogeneity and interdependence of the product characteristics.

Jeong, Kim, and Gang (2017) find that there is an inverted U-shaped relationship between product line length and competitive intensity, and that the firms following this strategy of adjusting product line length according to the competitive environment survive longer. Gang, Jeong, and Park (2018) similarly find an inverted U-shaped relationship between firm survival and product line length, which is determined by the industry lifecycle stage. Before an industry shakeout, increasing the length of the product line is a beneficial strategy, but the situation is inverted for the post-shakeout maturity stage (Gang et al. 2018). The authors deem this to be the result of coordination problems and cannibalization.

Performance effects of product line breadth

Within the strategy literature, there is still relatively little research on the effects of product line breadth, as length has been the main consideration for most studies. The studies that have analyzed breadth have yielded slightly different results. This is not surprising, since all three studies included here utilize different measures for analyzing product line breadth and define it in slightly different ways. The underlying premise was, however, deemed relatively similar to the definition of product line breadth adopted in this dissertation.

The studies on breadth and firm performance have found a U-shaped relationship (Dowell 2006; Barroso and Giarratana 2013) and a positive relationship (Giarratana and Fosfuri 2007) with performance. Dowell's (2006) study differs from the aforementioned two others in that its breadth measure not only incorporates the number of segments in which the firm is present, but also the materials used in the product lines. The study analyzes the US bicycle industry, and thus the material used in the frames is an important distinguishing factor between different types of products. Following this, Dowell's (2006) matrix on segment and material

combinations can in fact be seen as a more detailed segmentation approach, and thus the results can be compared to those of the other two analyses.

Dowell (2006) finds that firms with very narrow or very broad material–segment combinations survive better than those in the middle. The curve is mitigated by the length of the product line, and firms with longer product lines have slightly better survival chances when their breadth is moderate (Dowell 2006). One possible explanation for this relationship between breadth and firm performance is that the firms are "stuck in the middle." They are unable to benefit from the advantages of focusing on a narrow set of products, but they are not fully taking advantage of economies of scope, either (Kekre and Srinivasan 1990; Dowell 2006). Barroso and Giarratana (2013) find the same effect, proposing that it might be due to the costs associated with entering a new niche, as previously low process flexibility hinders the entry and once-loyal customers are possibly lost as the firm diversifies its presence into more than one niche. The findings on the positive relationship between increased breadth and firm performance indicate that a firm should focus on either a broad or a narrow strategy (Barroso and Giarratana 2013).

When utilizing a broad strategy, a firm should not possess very long product lines, and when utilizing a narrow one, the product line should be longer. This finding can possibly be explained by the resource-partitioning theory which states that mixed strategies reduce firm viability (Carroll 1985; Barroso and Giarratana 2013). While a specialist relies on a narrow and more focused resource base, relying on satisfying its specific range of customers with the products it offers in its specialized product category, a generalist takes advantage of a broad resource base while aiming for economies of both scale and scope in a number of product categories (Carroll 1985; Carroll and Swaminathan 2000). However, the result contradicts Dowell's (2006) finding that longer product lines actually increased firms' survival chances.

In related research streams, the possibility that firms might benefit from broader product lines has been attributed to the sharing of resources across different but related product markets, for example (Farjoun and Lai 1997; Gary 2005; Miller 2006). As sharing enables the exploitation of underutilized resources and creates synergies, production costs decrease or product value increases (Gupta and Govindarajan 1986; Zahavi and Lavie 2013), and the enhanced opportunities for resource sharing create economies of scope and render the redeployment of resources in another product category possible (Rumelt 1982; Helfat and Eisenhardt 2004; Li and Greenwood 2004). A broad product line strategy might prove to be particularly useful in fast-paced and unpredictable environments since the success of the firm is not dependent on only one product category (Dobrev et al. 2001; Hannan and

Freeman 1977). A broader product line also enables the firm to gain benefits from one-stop shopping since a wide variety of products are offered by the same firm. Brand loyalists can minimize their search costs, as they only look for their preferred brand, which now meets their needs even better (Sappington and Wernerfelt 1985; Giarratana and Fosfuri 2007; Ye et al. 2012). These effects of a broader product line may lead to increased consumption frequency and willingness to pay (Barroso and Giarratana 2013). A potential additional benefit comes from the competitive dynamics view. If a broad product line results in a situation where firms meet in multiple markets, the mutual forbearance hypothesis states that competition will diminish (Gimeno and Woo 1999).

From an organizational perspective, the broadening of the product line through new product introductions also has risks. New product introductions often require new routines to be put in place to design, produce, and distribute the product, requiring new or different employees and organizational capabilities (Tushman and Anderson 1986). As a consequence, the responsibilities of some positions may change, resulting in subsequent changes in the networks of relations and communications within the firm (Henderson and Clark 1990). In addition, new ties with other firms may need to be established and old ones changed in order to cater to the needs of the processes surrounding the new products (Rosenbloom and Christensen 1994). Accommodating these adjustments is a difficult task that seldom occurs optimally at first, but the initial problems are often overcome eventually, as learning takes place (Barnett and Freeman 2001).

Learning itself, however, also presents some risks in the form of negative transfer (Zahavi and Lavie 2013). Negative transfer refers to the human tendency to follow proven practices for performing a task that is similar to a familiar one, but with a distinct task, this can result in the wrong application of irrelevant knowledge, leading to poor performance (Novick 1988). In this situation, experience is also likely to positively affect the degree to which a firm is able to manage a broad product line (Romanelli 1989; Anderson 1995).

The population ecology view lends support to the risks associated with broader product lines, as researchers have found that a generalist strategy (i.e., being present in multiple product categories, implying a broad product line) has negative consequences, such as receiving less attention and legitimacy and poorer chances of success and survival (Dobrev et al. 2001; Zuckerman 1999; Hsu et al. 2009). Similarly, the previously mentioned benefits of multimarket contact might in fact prove the opposite, as firms meeting each other in multiple markets probably draw on similar knowledge and resource bases and thus compete strongly, constraining

each other's growth and threatening each other's survival (Hannan and Freeman 1977; Dowell 2006).

2.3 Hypotheses development

This section draws from the key theoretical perspectives and contributions of the research streams that are central to this study, as discussed earlier in this chapter. Based on these, the hypotheses proposed in this dissertation are formulated.

2.3.1 Impact of product line length on performance

In line with competitive dynamics research, firms act and react to competitors' actions in pursuit of market opportunities, attempting to fulfill consumer needs (Schumpeter 1942; Smith et al. 2001). In this vein, actions related to product line management, such as lengthening the product line by adding new products to it or pruning it to cut back on the number of products, are viewed as competitive moves that firms utilize to cope with changing competition and build and sustain a competitive advantage (Bayus and Putsis 1999; Barroso and Giarratana 2013; Jeong et al. 2017).

A number of risks related to longer product lines have been identified. Longer product lines often result in increased costs due to greater organizational, production, and logistics complexity (Quelch and Kenny 1994; Anderson 1995; Boulding and Christen 2009). The problems with production complexity may cause diseconomies of scale (Putsis 1997). All these additional costs are converted into higher prices, which in turn lead to lower demand (Bayus and Putsis 1999). Firms with longer product lines might also be weaker competitors, as they are forced to divide their resources among a wider set of products (Sorenson 2000).

At a certain point, cannibalization starts to create an issue since the products might not differ enough from each other and might reduce the sales of both (Barroso and Giarratana 2013; Wilson and Norton 1989; Moorthy and Png 1992; Axarloglou 2008). In addition to cannibalization, offering excessive variety may generate uncertainty in preferences and create a decision conflict, which delays the customer's purchasing decision (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992).

On the other hand, many studies have found a positive link between firm performance and product line length (Robinson and Fornell 1985; Kekre and Srinivasan 1990; Bayus and Putsis 1999; Barnett and Freeman 2001; Dowell 2006; Moreno and Terwiesch 2017). A longer product line allows the firm to respond to a wider range of customer needs and signals a responsiveness to changing needs

(Lancaster 1990; Shapiro and Varian 1998; Moreno and Terwiesch 2017), which in turn is linked with higher demand and market share (Bayus and Putsis 1999).

In addition, introducing new products to an existing product line in a segment in which the firm has prior knowledge benefits it through learning-by-doing effects by increasing management and operational efficiency (Kim and Kogut 1996; Kogut and Zander 1992; Smith et al. 2005). Consequently, the quality of the new products introduced increases (Eggers 2012). Firms may also be able to benefit from economies of scope, which further increases their market share and profits (Bailey and Friedlaender 1982; Kekre and Srinivasan 1990).

Over the past decade in particular, product line studies have increasingly incorporated a more diverse set of variables into their analyses, and this has yielded more results showing that the effects of lengthening the product line change from positive to negative under certain circumstances (e.g., Giarratana and Fosfuri 2007; Barroso and Giarratana 2013; Jeong et al. 2017). Longer product lines can be beneficial for the aforementioned reasons up until a certain point, but as product line length increases, factors such as decision conflict and cannibalization begin to have a bigger effect, finally resulting in lower firm performance as product lines grow longer. The first hypothesis is formulated as follows:

Hypothesis 1a: *There is an inverted U-shaped relationship between product line length and customer evaluations.*

2.3.2 Impact of product line breadth on performance

One of the potential benefits of broader product lines is that when firms enter multiple product lines they are able to exploit the excess productive capacity of their resources (Farjoun 1994; Markides and Williamson 1994; Tanriverdī and Lee 2008). This resource relatedness and sharing enables them to benefit from economies of scope (Davis and Thomas 1993). Since sharing enables the exploitation of underutilized resources and creates synergies, production costs decrease or product value increases (Gupta and Govindarajan 1986; Zahavi and Lavie 2013), and the enhanced opportunities for resource sharing create economies of scope and render the redeployment of resources in another product line possible (Rumelt 1982; Helfat and Eisenhardt 2004; Li and Greenwood 2004). In practice, a new, yet related, product line enables the firm to deploy similar personnel, R&D, and marketing assets, and leverage the same technologies (Stern and Henderson 2004; Zahavi and Lavie 2013).

In fast-paced and unpredictable environments a broad product line might shield the firm and yield it better survival chances, as its performance in the market is not dependent on only one product category (Dobrev et al. 2001; Hannan and Freeman 1977). Following the competitive dynamics view and the mutual forbearance hypothesis, a broad product line is also more likely to result in a situation where firms meet in multiple markets, diminishing the overall competition between them (Gimeno and Woo 1999). Broadening the product line may lead to increased consumption frequency and willingness to pay among customers, as customers are able to buy a wider variety of products from the same brand, and brand loyalists can minimize their search costs and buy products that meet their needs even better than before from their preferred brand (Sappington and Wernerfelt 1985; Giarratana and Fosfuri 2007; Ye et al. 2012; Barroso and Giarratana 2013).

However, there are also multiple risks related to the broadening of the product line through new product introductions. New routines, employees, and organizational capabilities for designing, producing, and distributing the products are required (Tushman and Anderson 1986), and accommodating these adjustments is difficult and may cause disruptions in the operations of the firm, until learning effects enable the firm to overcome the initial difficulties (Barnett and Freeman 2001). Learning itself, however, also presents some risks in the form of negative transfer (Zahavi and Lavie 2013).

Other negative consequences of broad product lines include receiving less attention and legitimacy and poorer chances of success and survival (Dobrev et al. 2001; Zuckerman 1999; Hsu et al. 2009). The cannibalization threat also ensues (Cottrell and Nault 2004). Similarly, the benefits of multimarket contact mentioned earlier might in fact prove the opposite, as firms meeting each other in multiple markets probably draw on similar knowledge and resource bases and thus compete strongly, constraining each other's growth and survival possibilities (Hannan and Freeman 1977; Dowell 2006).

More recent studies on product line breadth and firm performance have found a U-shaped relationship (Dowell 2006; Barroso and Giarratana 2013). A possible explanation for this is that the firms with moderately broad product lines are "stuck in the middle," unable to benefit from the advantages of focusing on a narrow set of products while not fully taking advantage of economies of scope, either (Kekre and Srinivasan 1990; Dowell 2006). It might also be due to the costs associated with entering a new niche, as previously low process flexibility hinders the entry and previously loyal customers are possibly lost as the firm diversifies its presence into more than one niche. In the case of a very narrow product line, the firm is able to

take advantage of the benefits gained by a specialist strategy (Hsu et al. 2009). The second hypothesis is thus formulated as follows:

Hypothesis 2a: *There is a U-shaped relationship between product line breadth and customer evaluations.*

2.3.3 The effects of competitive intensity on firms' product line strategies

Overall, industry competitive intensity is a crucial determinant of firms' competitive behavior. Besides its effects on resource availability, profitability, pricing, market positioning, and other characteristics of a firm's competitive repertoire, changes in competitive intensity have been found to significantly affect firms' product strategies, too (e.g., Giachetti and Dagnino 2014; Jeong et al. 2017; Gang et al. 2018). In line with competitive dynamics literature, an industry's competitive environment plays an important role in shaping firms' product line strategy (Sorenson 2000; Giachetti and Dagnino 2014), and firms' product line strategies have been considered among the competitive moves firms use to defend their market share and profits and react to changes in the competitive environment (Jeong et al. 2017).

Studies have found an inverted U-shaped relationship between competitive intensity and product line length (Giachetti and Dagnino 2014; Jeong et al. 2017) and a higher survival rate for firms that follow a product line strategy of adjusting to changes in competitive intensity (Jeong et al. 2017). Increased competitive intensity prompts firms to defend their market positions, as they seek to defend the resources they have previously invested (Ferrier et al. 2002). Incumbent firms might use product line lengthening as a strategy, since offering a wider variety of products is seen as a way of preventing existing customers from changing to rivaling products (Klemperer 1995). The potential downsides of these tactics are the problems with coordination and decision-making speed that firms with very long product lines often face (Jones 2003). The negative effect of these complications is exacerbated in high-intensity environments, where the ability to quickly and flexibly respond to rivals' competitive actions is vital (Draganska and Jain 2005).

Thus far, the relationship between product line breadth and competitive intensity has yet to be analyzed. Under high levels of competitive intensity, firm presence in more than one product line might shield it from potential problems in one particular product line, since its overall performance is not solely dependent on that product line. However, if competitive intensity in most of the product lines is high, being able to effectively respond to rivals' competitive moves requires resources and an

ability to react quickly. If the firm has a broad product line, it might be forced to stretch its resources too thin, thereby hindering an effective response. Similarly, as with very long product lines, extensive breadth of the product line presents the firm with coordination complexities that affect its decision-making speed (Jones 2003). These problems may, however, be tackled through learning from experience, which is gathered when the firm enters a number of product lines successfully. Consequently, a firm with a very broad product line might do better under intensive competition, as it has gained more experience from coping with these types of situations.

On the other hand, when increased competitive intensity is viewed from the perspective of higher product density in the industry, it results in more variety for the customers and thus affects firm performance from the point of view of customers. Increased competitive intensity in the form of increased variety might improve product and firm performance, as many consumers in fact seek variety and want to make their purchase selection from an array of different products (Kahn 1995). Similarly, preference uncertainty may lead to variety-seeking behavior, as consumers are uncertain of their current or future preferences (Simonson 1990).

There are downsides to increased competitive intensity from the customer's point of view as well. If firms consistently offer longer product lines and thus more variety, they are forced to divide their resources among more products, potentially resulting in lower quality products, which customers value less (Sorenson 2000). Product prices may also rise, thereby lowering demand and further resulting in a situation in which a customer might perceive the price–quality ratio of the product to be lower (Bayus and Putsis 1999).

The choice overload hypothesis also states that too much variety may have adverse consequences (Scheibehenne et al. 2010), since it might result in uncertainty in preferences and a decision conflict (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992), difficulties with committing to a choice and motivating oneself to choose, and a decrease in the overall preference strength and satisfaction with the chosen product (Iyengar and Lepper 2000). Increased variety may also lead to increased feelings of disappointment and regret (Schwartz 2000). These effects may lead to consumers perceiving the quality of the products more critically, lowering their perception of the product's performance. Consequently, the last two hypotheses state:

Hypothesis 1b[1]: *Competitive intensity moderates the relationship between product line length and firm performance so that the relationship will be stronger under higher competitive intensity.*

Hypothesis 2b: *Competitive intensity moderates the relationship between product line breadth and firm performance so that the relationship will be stronger under higher competitive intensity.*

[1] This notation is used in the numbering of the hypotheses, as the results of the analyses are later more logically presented in the order where product line length and possible moderating effects, and product line breadth and the possible moderating effects are both presented separately.

3 RESEARCH METHODOLOGY

3.1 Industry setting

This study is set in the digital camera industry and covers the period from January 1, 1999 to December 31, 2017. During this time, the competitive dynamics of the digital camera industry underwent tremendous changes. Figure 6 portrays the number of new yearly entries to the industry, the number of exits from it, and the overall number of firms participating in the industry during the study period. As can be noted, there has been a steady decline in the number of firms in the industry, with the number of exits reaching an average of 6.5 per year.

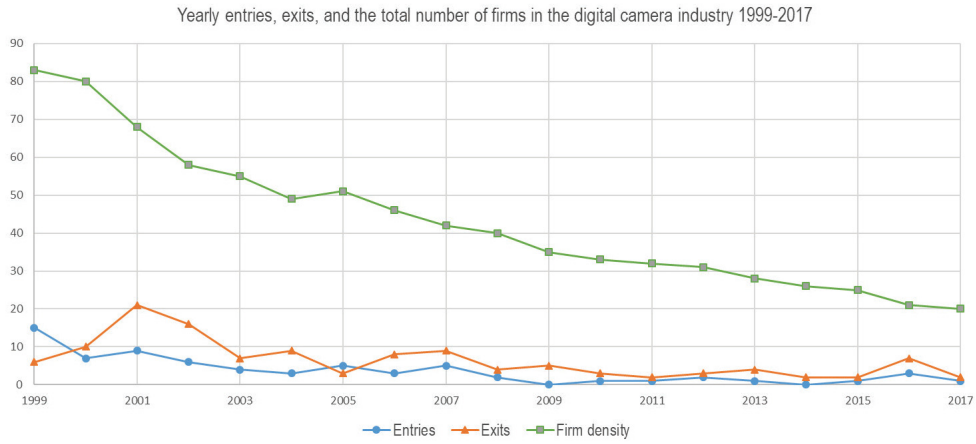


Figure 6. The number of firms in the digital camera industry.

Whereas the number of firms experienced a continuous decline, the number of new product introductions rose considerably during the period of study—from around 130 product launches in 1999 to approximately 400 in 2010—before experiencing a sharp decline to only 48 new introductions in 2017. A similar pattern is observed in the product line length of the firm with the longest line in a given year. These are depicted in Figure 7.

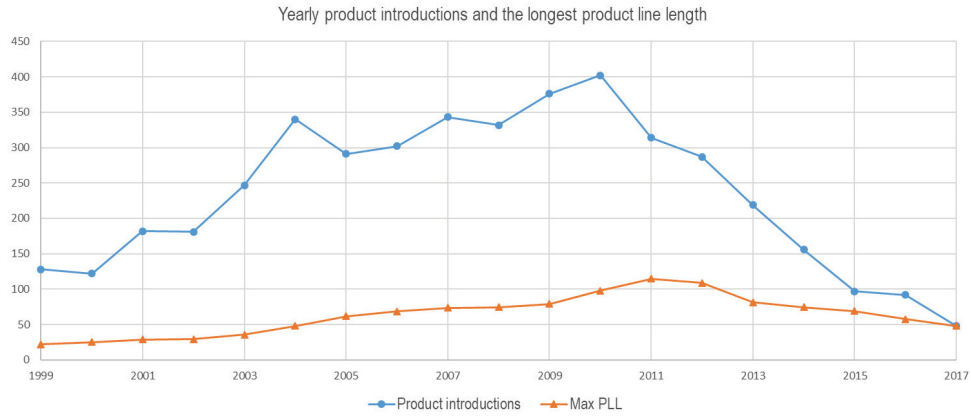


Figure 7. The number of yearly product introductions and the length of the longest product line of a firm in the digital camera industry, 1999–2017.

The digital camera industry has been quite heterogeneous and large and witnessed long periods of intense competition between numerous camera manufacturers (Kang and Song 2017). Overall, 94 different brands have been present in the market since 1999 and introduced nearly 4,500 camera models. However, of these firms, only 20 introduced new digital cameras in 2017. Thus, nearly 80 percent of companies or brands that once took part in the industry, exited the market during the period of analysis.

A digital still camera is a device designed to capture information about the environment into an image. The digital camera converts the information it captures into an electronic signal and stores it in a digital format. An image sensor behind the optical lens of the camera, consisting of an array of pixels, records and converts the optical image into an electronic signal (Toyoda 2006). Currently, there are two main types of technologies used in imaging sensors on the market: the charge-coupled device (CCD) sensor and the complementary metal-oxide semiconductor (CMOS) sensor. As the image quality of CMOS sensors has improved in recent years, digital camera manufacturers have increasingly preferred to use this technology over CCD sensors in all camera segments.

Within a technology-intensive industry, there often are particular product attributes that shape and define the criteria that customers use to evaluate and rate the products. These attributes comprise the basis of competition in the industry (Christensen 1997). Based on industry professionals' accounts, resolution, and the sensor size used to produce this resolution, has been especially important in the digital camera industry (e.g., Xiao 2008; Benner and Tripsas 2012). For many years,

digital camera manufacturers constantly attempted to achieve higher resolutions, and digital camera marketing focused intensely on these values.

The global digital camera industry provides an ideal setting for this study because competition in the industry has been intense, and on the face of it, firms have actively adjusted their product lines to cope with the changing environment. Both the length and breadth of digital camera manufacturers' product lines have experienced significant changes. In recent years, the compact camera product category has experienced convergence with the smartphone industry, as consumers increasingly substitute their use of compact cameras with the cameras in their smartphones. This has led to a significant shortening of product lines in the product category.

3.2 Data collection

The hypotheses were tested in the context of the global digital camera industry. Data on digital camera models introduced from the beginning of 1999 until the end of 2017 were collected from a wide range of online sources to ensure the highest possible coverage of global digital camera introductions. The core data was gathered from special interest websites deemed to include the most camera models, namely: DPReview (https://www.dpreview.com), Imaging Resource (https://www.imaging-resource.com), digitalkamera.de (https://digitalkamera.de), Digital Camera Database (https://www.digicamdb.com), and DXOMARK (https://www.dxomark.com). As it was found that the websites used did not adequately represent all digital cameras sold in the industry at different times, the data was supplemented using each manufacturer's own website, which often contained information on all the models marketed under a specific product family (e.g., Canon's IXUS, Olympus's Stylus, Panasonic's Lumix, etc.). Individual missing values were also sought from CNET (https://www.cnet.com), the manufacturers' own websites, and camera manuals found online.

The complete dataset consisted of 4,459 digital camera models introduced between January 1999 and December 2017. Of these, customer evaluation data was found for 2,033 cameras. The customer evaluations were gathered from four different websites: Imaging Resource, DPReview, Amazon (https://www.amazon.com), and What Digital Camera (https://www.whatdigitalcamera.com). The data was triangulated between three researchers to ensure its consistency. The collected variables for each model included manufacturer, release date, price, sensor type, sensor size, effective number of

megapixels, focal length, weight, body type, shutter speed, viewfinder type, screen size, screen resolution, and data on digital and/or optical zoom.

As the digital camera industry has evolved, three sub-categories of digital cameras have formed: DSLR, i.e., digital SLR (high-end), bridge (mid-range), and compact (low-end) cameras. Since the focus of this study is on the mass market for digital cameras, the types of digital cameras that were determined as separate submarkets experiencing their own technological evolution and variation processes were excluded (see, e.g., Benner and Tripsas 2012). These included still video cameras, video cameras, webcams, studio/professional cameras, underwater cameras, single-use cameras, camcorders, action cameras, drones, and lens-style cameras. Thus, the final dataset consisted of digital cameras that could be classified as either SLR, bridge, or compact cameras. In light of the definitions adopted in this study in Chapter 2, section 2.2.2, and illustrated in Figure 5, the three categories of SLR, bridge, and compact each represent distinct product categories and, as such, distinct product lines. Combined, they constitute the mainstream consumer digital camera submarket, which is a part of the digital camera industry. The excluded camera types aforementioned constitute their own submarkets within the industry, but their classification into these submarkets is not pertinent to this dissertation.

The categorization into three product segments was mainly based on information from the websites, as many of them listed the products as belonging to one of the categories used in the study. However, the categorizations were reviewed and verified also by other researchers and missing data was added based on evaluations of the technical parameters of the product category. SLR cameras are the most advanced in terms of technology, and they are the most expensive. They were distinguished based on two simultaneous attributes: 1) the availability of an instant return mirror mechanism and prism system and 2) lens interchangeability. Bridge cameras are also highly advanced, but they usually do not include a mirror system. This category includes electronic viewfinder cameras, mirrorless interchangeable lens cameras, compact system cameras without a mirror mechanism, cameras with a mirror mechanism but with fixed lenses, single lens display cameras, rangefinder-style cameras, mid-sized cameras with manual settings for shutter speed, aperture, ISO sensitivity, color balance, and metering, advanced mid-sized cameras with a large imaging sensor, and advanced mid-sized cameras with extended zoom. Finally, compact cameras include pocketable cameras that commonly do not feature an optical viewfinder. In addition, this category includes pocketable zoom cameras and consumer point-and-shoot cameras that incorporate basic-level functionality and optics. These cameras generally belong to the lowest price segment.

The customer evaluations originally assumed slightly different forms in the different sources, with some variances in the scales used. For example, the What Digital Camera site provided evaluations in percentages and for a number of different qualities of the camera, e.g. design, features, performance etc. For these evaluations, the overall score provided by the site was utilized and scaled to the same range used by the other sites, that of zero to five. If the product had multiple reviews on multiple sites, an average value was calculated. No qualitative data on customer evaluations was used, but all data was in a numerical form.

The firm-level control variables were mainly gathered from each manufacturer's own website. When needed, other relevant sources of information were used. The data included firm age, firm size based on revenue, firm size based on the number of full-time employees, R&D budget, country of origin, profit, and CEO tenure. Based on the dataset, 94 firms introduced products in the digital camera market during the period of analysis. Thirty-five different manufacturers produced the 2,033 camera models for which customer evaluations were found. In evaluating the representativeness of the data, it seems that customer evaluations were mainly not found for the very small firms with very short product lines and very brief tenure in the digital camera industry overall. This is not surprising, given that the information was gathered from online, mainstream sources. Since all of the large, well-known manufacturers are present, they controlled a significant majority of the market share of the industry during the period of analysis. Thus, the data is representative of the mainstream digital camera market and the cameras that have, in general, been visible to most of the customers.

3.3 Selection of variables

3.3.1 Dependent variable

Online customer evaluations. The dependent variable in the study is the online customer evaluations of digital cameras, depicting firm performance, as presented in Chapter 2, section 2.2.4.

3.3.2 Independent variables

Product line length. The firm's product line length was measured as the number of product models of firm *i* at time *t* within the specific submarket.

Since there was no information available regarding the exact date on which the production of a model was discontinued by the manufacturer, following Giachetti and Dagnino (2014) and Giachetti and Lampel (2010), industry experts from retail and specialist stores were interviewed to gain an understanding of how long manufacturers offer camera models to retailers (i.e., the length of time that manufacturers keep a product in their product line). Similar to mobile phones, digital cameras are high-technology products that experience rapid performance development and are mostly sold to final customers through retailers. Retailers might continue selling the products to customers even after the manufacturer has ceased selling it, and thus it is important to determine how long the manufacturer offers the products to retailers. Based on the interviews, the average product lifetime during the period of study was around two years for compact digital cameras, with these cameras experiencing shorter lifetimes of around one year in the beginning of the period of analysis and longer lifetimes, some even close to three or four years, during the last few years of the period. For bridge cameras, the dynamics were deemed relatively similar by the experts, but for digital SLR cameras, the traditional introduction period lasted for around four years. Based on these evaluations, the length of time that a product remains in a firm's product line was determined to be two years for compact and bridge cameras and four years for SLRs. These categorizations are reviewed in more detail in section 3.2. An introduction date of the first of each month was also assumed, as there were discrepancies in the introduction dates between different data sources.

Product line breadth. The firm's product line breadth was measured as the number of product lines of firm i at time t within the industry (Dowell 2006). Similar product lifespans described in relation to product line length were assumed.

Competitive intensity. Industry competitive intensity has been measured in a number of ways in previous research, as was more thoroughly discussed in Chapter 2, sections 2.1.2 and 2.2.3. Following research in the competitive dynamics stream (e.g., Smith et al. 1992; Ferrier et al. 1999), competitive intensity has been considered through firms' actions and responses, their aggressiveness, speed, and pattern (Chen 1996), or merely through the frequency of these actions (Andrevski et al. 2014). Competitive intensity is high when the number of competitive actions between all firms in the industry is high (Young et al. 1996; Andrevski et al. 2014). Consequently, when firms carry out competitive actions frequently, they compete intensely, contributing to the competitive intensity of the industry as a whole. Following this

line of thought, in industries where competition is intense and the number of actions is high, the response lag is often very short, which also reflects industry competitive intensity (Grimm and Smith 1997). Another theoretical proxy utilized for analyzing the intensity of competition in an industry has been the rate of market entry and exit: a high entry rate is an indication of increased competitive intensity, similar to a high exit rate (Baum and Korn 1996). This competitive dynamics view of competitive intensity views the product line actions of firms as originating from the actions of their rivals and thus the overall competitive intensity of the industry. The response lag and the time it takes firms to develop and launch new products necessitate the use of a competitive intensity measure that takes the time lag of organizational decision-making into account. In making product line-related decisions, managers consider and evaluate information on the competitive situation in the industry at that specific moment and a certain period of time before that in order to make an informed forecast on the future of the competitive landscape of the industry.

In this study, competitive intensity was measured as the frequency of new product introductions (Barnett and Freeman 2001; Bordley 2003; Jones 2003) as a proxy for the frequency of all competitive actions in the industry, which would even more accurately depict competitive intensity (Andrevski et al. 2014). Competition is intense when firms in the industry introduce multiple new products that crowd the product space, forcing the firms to compete even more intensely and generating more variety for customers in the marketplace (Sorenson 2000; Barroso and Giarratana 2013). The annual product introduction rate is depicted in Figure 7. Competitive intensity was calculated from the complete dataset of 4,459 camera models, as they portray the actual intensity of competition in the industry.

The frequency of new product introductions is measured as the yearly average number of new product introductions i of all firms j in the industry during the period $t-1$ to t. The lagged moving average value from the previous 12 months is utilized since a firm's product introduction decision is expected to be influenced by competitive intensity and thus rivals' competitive actions in an earlier period, and this enables an analysis of its potential effects on product line length (Bowen and Wiersema 2005; Giachetti and Dagnino 2014).

3.3.3 Control variables

A number of industry-level, firm-level, and product-level controls are introduced to account for their effects on the performance of the firms' products.

Firm density. The number of firms in an industry is an important measure of its competitive structure (Porter 1980; Boone 2000; Jeong et al. 2017). Firm density is a commonly used measure derived from ecological research, as it depicts the competitive conditions of the industry at a given time (Dowell 2006) and has been found to have a remarkable effect on firm survival (Hannan and Carroll 1992). Firm density was measured as the number of firms operating in the digital camera industry during the year of analysis (e.g., Barroso and Giarratana 2013). As firm density was considered as a year-based measure, firms were presumed to have exited the market in the year when their product line length was measured as zero (i.e., if the last product in the firm's product line was considered to be discontinued in August 2009, for example, then the firm itself exited the market in 2010, since this was the first complete year in which it was not present in the market).

Product density. Industry density and competitive structure is also depicted through industry product density—the number of all products on the market (Sorenson 2000). The variable has been commonly used by product line researchers, as it has the potential to both negatively and positively influence firm performance, with some finding no effect whatsoever (Bayus and Putsis 1999; Sorenson 2000; Barnett and Freeman 2001; Barroso and Giarratana 2013). The number of products in the industry affects the overall competitive environment, as firms might have more limited possibilities to gain market share when the market is overpopulated (Bayus and Putsis 1999).

Firm tenure in the industry. The firm tenure in the industry variable is used to capture the firm's experience in the market, and it is commonly included in studies because firms with more industry experience tend to be more likely to survive due to learning effects, for example (Scherer and Ross 1990; Bayus and Putsis 1999). Through more experience in the industry, firms often obtain experience in production and R&D, form external relationships, and develop technological competencies (Tushman and Anderson 1986; Sørensen and Stuart 2000). On the other hand, more experienced firms may face problems with updating their competencies if they have previously been successful with their established competencies (Levitt and March 1988). Tenure in the industry was measured as the number of years since the introduction of the firm's first product in the digital camera industry, analyzing the industry since its emergence in 1989.

Firm age. Firm age as a control variable is also related to firm experience, as older firms have usually had time to acquire capabilities that they can exploit in a number of industries (Jones 2003), whereas newly formed firms are still developing firm-specific competencies, training employees, and strengthening and solidifying relationships within the firm and between the firm and its stakeholders (Stinchcombe 1965; Henderson 1999; Dowell 2006). More experience in the industry might also enable the firm to better manage the costs of increased product line length and/or breadth (Anderson 1995). However, firm age has been found to negatively affect technical quality (Balasubramanian and Lee 2008), and older firms often face problems related to conservatism and blindness, leading to weaker performance (Evans 1963; Dunne and Hughes 1994; Durand and Coeurderoy 2001). In this study, firm age was calculated from the year of founding.

Firm size. Firm performance is commonly positively affected by firm size (Agarwal and Audretsch 2001). This has been credited to larger firms having better access to capital and trained workers (Aldrich and Auster 1986), legitimacy with external stakeholders (Baum and Oliver 1991), and possessing a greater resource base, which enables larger investments in R&D and the ability to obtain and maintain a variety of resources required in both pre- and post-shakeout eras (Agarwal et al. 2002). Being able to invest in R&D also enables the development of better and higher-quality products, as the firm has more resources to divide among a wider set of products (Sorenson 2000). In addition, following the AMC model of competitive dynamics, firm size can be viewed as a measure of a firm's capability to respond to competitive moves made by its rivals and its ability to become aware of these actions (Smith et al. 1991; Chen et al. 2007; Giachetti and Dagnino 2014). In this study, the annual turnover of a firm was utilized as a measure of firm size.

Product quality. As this dissertation analyzes competition between firms through product line decisions especially, the technical performance of the products is considered an important control variable. The technical performance of products is also often used as a proxy for the quality of products in technology-intensive industries, such as the digital camera industry (e.g., Robinson and Fornell 1985; Jeong et al. 2017). With shorter product lines, it is often easier for firms to develop higher-performing products, as they can focus their development resources on a few key products, instead of dividing them between a variety of products (Jeong et al. 2017).

In addition, especially within technology-intensive industries, there are often particular product attributes that define and shape the criteria by which customers

evaluate and rate the products, creating the basis of competition in an industry (Christensen 1997). Thus, the technological performance of a product can often be measured through specific quantifiable variables, such as the printing speed in the printer industry (Gang et al. 2018). This acts as an objective valuation of product quality as compared to the dependent variable of customer evaluations, which measure customer-perceived quality not pertaining to a particular attribute of the product (Zeithaml 1988). For the digital camera industry, these types of product attributes are megapixel quantity and sensor size, which are used to control for the quality of the digital cameras in a firm's product line.

Sensor technology. Two significantly different sensor technologies have been used in the digital camera industry throughout its evolution: CCD and CMOS sensors. A dummy variable was used to control for the differences between them.

3.4 Data handling and methods

3.4.1 Missing data handling

The final dataset consisted of 2,033 cameras, but for some of them, information on all of the analyzed variables could not be found. As the dataset was already constructed so that only the cameras for which customer evaluations were found were included, most of the variables of interest in this study were not missing any additional values. For the technical performance measures of the products, namely the quantity of megapixels and the sensor size, only 0.1 percent and 1 percent of values were missing, respectively. For firm size, measured in yearly turnover of the firm, 14.5 percent of data points were missing. However, in light of these values, missing data is not a substantial problem in the sample, except in terms of the firm size variable (Scheffer 2002).

To address the issue, a method for missing data handling was needed for running the analyses. One of the most commonly used methods is to simply exclude all of the cases that are missing any data for any of the variables used in the study, also known as listwise deletion (Allison 2002). This method is most suitable when the data is *missing completely at random* (MCAR), that is, the occurrence of missing data is random and independent of the variables in the dataset (Little 1988). However, this is quite rarely the case, and based on the results of Little's MCAR test (Little 1988), the missing data in the dataset is not MCAR. In fact, there is fair reason to assume

that the data is *not missing at random* (NMAR), as the firm size values were commonly harder to find for small, non-public companies, for companies based outside of Europe, the US or Japan, and for companies that did not exist anymore.

The data was analyzed using listwise deletion, as it is in fact quite robust to violations of *missing at random* (MAR) among the independent variables in a regression analysis (Allison 2002). As there is no test to identify for certain if the data is MAR or NMAR, sensitivity analysis of the results is often recommended (Rubin 1987). For NMAR type data, multiple imputation has been deemed the most reliable, especially at missingness levels of less than 25 percent, as in this case (Scheffer 2002; Allison 2002). Thus, sensitivity analysis of the results was performed using multiple imputation, which yielded quite similar results with only very small variations in for example mean levels and standard deviations. Based on this analysis, listwise deletion was selected as the method for handling missing values.

3.4.2 Outlier handling

An outlier is generally considered an observation with a value that falls very far from the norm for a variable (Stevens 1984). The presence of these outliers in the data can lead to inflated error rates and distortions in statistic estimates in analyses (Zimmerman 1994; Zimmerman 1995). Commonly, they may decrease the quality and precision of the results substantially, and as such, their removal has been found to increase the accuracy of the results considerably, while also lowering error rates (Osborne and Overbay 2008).

The presence of outliers can arise from different causes: from errors in the data, or from the inherent variation in the data (Anscombe 1960). Consequently, some of the outliers are considered illegitimate, some legitimate, and not all of the illegitimate scores present as outliers in the data (Barnett and Lewis 1994). A common recommendation is to delete either both the illegitimate and legitimate outliers, or use transformations to keep the legitimate ones if one knows them to be such (Osborne and Overbay 2008). Some researchers argue that in the case of outliers that are suspected of being legitimate, they should not be removed, as the data is then more likely to be representative of the population as a whole (Orr et al. 1991). In the case of the data in this dissertation, the outliers can be presumed to belong to both classes. Based on the triangulation of the data and random verifications of the data points, there is a small possibility of some incorrectness in the values. However, there is also the option of legitimate outliers, as some models of some manufacturers have differed significantly from the most common ones sold at the time.

For this reason, sensitivity analysis was also performed to determine the method for outlier handling. To ascertain the reliability of the results, all of the analyses were run both with a dataset including all values and with a dataset from which outliers had been removed. Cook's distance (Cook 1977) is perhaps the most commonly used method for identifying influential outliers in a set of data (Osborne and Overbay 2008; Williams et al. 2013), and it was used in this study in all of the models separately.

3.4.3 Methods of analysis

Hierarchical linear regression (HR) was used to analyze hypotheses 1a and 2a, as it is an effective way to determine whether an independent variable explains a statistically significant amount of variance in the dependent variable after all other variables have been accounted for (Frey 2018).

Moderated hierarchical multiple regression was used for the analyses of hypotheses 1b and 2b. Although the usefulness of the hierarchical addition of variables has been questioned, the benefit of this method is again in producing results from which it is possible to interpret the significance and increase in the explanatory power (R^2) of the model by the interaction term used to model the moderation (Dawson 2014).

As a linear relationship is expected between product line length and firm performance, and product line breadth and firm performance, their statistical models were constructed as such. Thus, hypotheses 1a yields the following model:

$$CuE_{ijt} = \alpha + \beta_1 PLL_{it} + W_{ijt} + X_{it} + Z_t + \varepsilon, \quad (1)$$

where PLL_{it} is the product line length of firm i at time t, CuE_{ijt} the customer evaluations of the product j, W_{ijt} the product-level control variables, X_{it} the firm-level control variables, and Z_t the product category –level controls.

Since hypothesis 1b assumes a moderation effect of competitive intensity on the relationship between product line length and product performance, it is portrayed by the following model:

$$CuE = \alpha + \beta_1 PLL_{it} + \beta_2 CI_t + \beta_3 PLL_{it} CI_t + W_{ijt} + X_{it} + Z_t + \varepsilon, \quad (2)$$

where CI_t is the competitive intensity of the industry at time t, and $PLL_{it}CI_t$ is the interaction term used to test for moderation in the model.

Hypothesis 2a is formulated as follows:

$$CuE = \alpha + \beta_1 PLB_{it} + W_{ijt} + X_{it} + Z_t + \varepsilon, \quad (3)$$

where PLB_{it} is the product line length of firm *i* at time *t*.

And for hypothesis 2b, the relationship is described by the following model:

$$CuE = \alpha + \beta_1 PLB_{it} + \beta_2 CI_t + \beta_3 PLB_{it} CI_t + W_{ijt} + X_{it} + Z_t + \varepsilon. \quad (4)$$

The analyses were conducted by constructing a sequence of models that were analyzed separately. Table 4 portrays the models constructed for the analyses of each of the hypotheses of the study. The independent variables used in each of the models are also listed. In addition, each of the models included the control variables that were determined in models 1 and 8.

Table 4. The sequence of analyses and the independent variables in each of the models. Dependent variable: customer evaluations.

DV: Customer evaluations (CuE)	
Hypothesis 1a	
Model 1	Baseline model: Control variables
Model 2	Linear model: Product line length (PLL)
Model 3	Curvilinear model: PLL, PLL^2
Hypothesis 1b	
Model 4	Linear model: PLL, Competitive intensity (CI)
Model 5	Linear moderation: PLL, CI, PLL × CI
Model 6	Curvilinear model: PLL, PLL^2, CI
Model 7	Curvilinear moderation: PLL, PLL^2, CI, PLL^2 × CI
Hypothesis 2a	
Model 8	Baseline model: Control variables
Model 9	Linear model: Product line breadth (PLB)
Model 10	Curvilinear model: PLB, PLB^2
Hypothesis 2b	
Model 11	Linear model: PLB, CI
Model 12	Linear moderation: PLB, CI, PLB × CI
Model 13	Curvilinear model: PLB, PLB^2, CI
Model 14	Curvilinear moderation: PLB, PLB^2, CI, PLB^2 × CI

4 RESULTS AND DISCUSSION

4.1 Method fit and descriptive statistics

Since HR is basically an extension of multiple linear regression (MR) (Frey 2018), the variables and the model itself must meet certain conditions for HR to analyze them. The central assumptions related to using MR models include the following: 1) linearity in parameters; 2) independence of errors; 3) homoscedasticity of errors; 4) normal distribution of errors; 5) absence of severe multicollinearity; and 6) the absence of significant outliers (Osborne and Waters 2002; Williams et al. 2013). These are next reviewed in greater detail.

The linearity in parameters assumption refers to the presumption that the dependent variable Y is a linear function of the parameters (e.g., β_1, β_2, etc.) but not necessarily of the independent variables (X_1, X_2, etc.). From this assumption, it follows that in addition to basic linear equations it is also possible to model quadratic relationships between X and Y, for example (Williams et al. 2013). The first assumption was tested by plotting the standardized residuals against the expected values of the dependent variable Y and by fitting a Loess curve through it, as presented in Figure 6. As the Loess curve implies a roughly linear relationship between the two variables around zero, a linearity in parameters can be concluded.

The second assumption presumes an independence of errors, meaning that the errors of one observation are uncorrelated with the errors of other observations (Stolzenberg 2004; Williams et al. 2013). The presence of this type of autocorrelation can be tested using the Durbin–Watson test (Durbin and Watson 1951). A commonly used range of approvable Durbin–Watson statistic values is from 1.5 to 2.5, as a value of 2 indicates no autocorrelation (Field 2009, p. 220). The Durbin–Watson statistic was calculated for each regression analysis and was always within the acceptable range, most often varying between 1.7 and 2.1, indicating no cause for concern in terms of autocorrelation.

The third condition assumes homoscedasticity of errors, which refers to the variance of the residuals being homogeneous across all levels of the independent variables (Williams et al. 2013; Osborne and Waters 2002). The assumption can be checked using the same plot portrayed in Figure 8. The residuals should ideally be

randomly scattered around 0, but slight heteroscedasticity has been found to have little effect on the results (Berry and Feldman 1985).

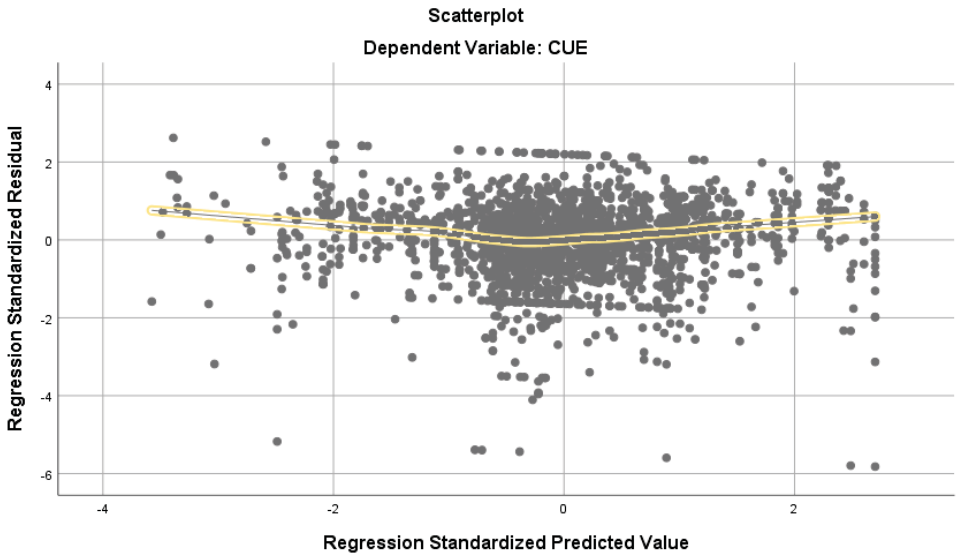


Figure 8. Scatterplot of the standardized predicted value with the standardized residuals and a fitted Loess curve.

The fourth condition stipulates that the residuals should be normally distributed (Stolzenberg 2004). This assumption is primarily important for small samples (Williams et al. 2013), but it was tested nonetheless for each of the analyses separately using a normal probability plot (P-P plot) of standardized residuals, which confirmed the normality of residuals. An example of the plot for the whole dataset is presented in Figure 9.

The fifth assumption has to do with multicollinearity. It refers to the presence of high correlations between multiple independent variables, which leads to quite large sampling errors of the partial slopes and partial correlations, possibly distorting the regression coefficients (Blalock 1963). The magnitude of this problem can be evaluated using variance inflation factors (VIFs), which should not exceed scores over 10 (Chatterjee and Hadi 2006). Some of the control variables used in the study turned out to be relatively highly correlated, and this problem was addressed by excluding one of the variables causing the multicollinearity. For the results reported in this chapter, the VIFs did not exceed acceptable scores.

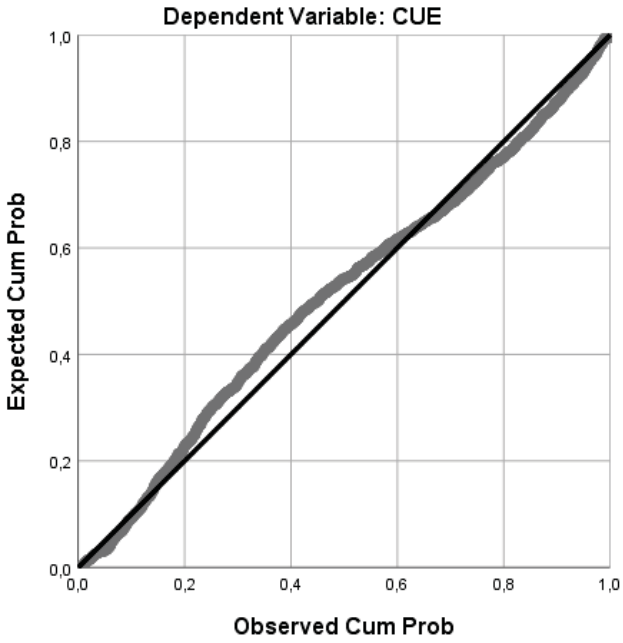


Figure 9. Normality of residuals P-P plot.

The last condition relates to the presence of significant outliers, since the regression results might in some cases be heavily influenced by a few individual observations in the data that have very unusual values (Stevens 1984; Williams et al. 2013). Outlier handling was previously discussed in section 3.4.2.

Based on these evaluations, it is possible to conclude that hierarchical multiple linear regression and moderated multiple linear regression can be applied to the data in this study. Descriptive statistics and correlations between variables are depicted in Table 5. The correlation table also portrays the same findings as later in the analyses: industry product density is quite highly correlated with the overall competitive intensity of the industry, and industry firm density seems to correlate with firm tenure in the industry. These relationships were taken into account in the analyses. If multicollinearity was an issue, industry product density or industry firm density was left out from the model to ensure the analyses correctly portrayed the competitive intensity measure. The following sections present the results of the models depicted in Table 4 in Chapter 3, section 3.4.3, and briefly discuss their key findings. Chapter 4.4 will delve deeper into the findings and their bases in and implications for the present theory.

Table 5. Descriptive statistics.

All product categories

Variable	Mean	S.D.	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11
1 Customer evaluations	3.856	0.524	1.00	5.00	1										
2 Product line length (PLL)	44.826	26.009	1	135	0.067**	1									
3 Product line breadth (PLB)	2.396	0.653	1	3	0.172***	.445***	1								
4 Competitive intensity (CI)	20.079	7.157	1.33	35.92	-.058**	.492***	.341***	1							
5 Megapixels	10.699	6.604	.30	51.40	.335***	.397***	.474***	.214***	1						
6 Sensor size	104.921	190.219	7.68	1452.00	.338***	-.032	.153***	-.079***	.547***	1					
7 Firm age	82.705	19.083	3	160	-.088***	-.026	.236***	.066**	.084***	-.033	1				
8 Firm size	39031.728	40670.285	132.88	216708.68	.079**	.16***	-.057*	.194***	.152***	-.005	-.312***	1			
9 Firm tenure	13.657	5.015	0	27	.182***	.561***	.553***	.287***	.709***	.139***	.291***	-.136***	1		
10 Industry firm density	40.686	13.642	20	83	-.248***	-.495***	-.504***	-.393***	-.793***	-.220***	-.106***	-.178***	-.802***	1	
11 Industry product density	588.289	184.202	38	858	-.052*	.512***	.327***	.915***	.184***	-.086***	.086***	.181***	.285***	-.414***	1

Notes: ***p<.001; **p<.01; *p<.05

4.2 The relationship between product line length and performance and the moderating effect of competitive intensity

This chapter presents the hierarchical multiple regression and the moderated hierarchical multiple regression results of the models analyzing hypotheses 1a and 1b, concerning the relationship between product line length and customer evaluations as well as the moderating effect of competitive intensity on this relationship in all of the product categories combined and in each of them separately. As depicted in Table 4, models 1–3 involve hypothesis 1a, whereas models 4–7 involve hypothesis 1b. Table 6 presents the results for the entire industry, combining all of the product categories and analyzing them together. In the model notation, model A1 refers to model 1 with all of the product categories, C1 with compact cameras, B1 with bridge cameras, and S1 with SLRs.

Table 6. Results of the regression models on the relationship between product line length and customer evaluations for all product categories; unstandardized beta coefficients.

All categories (compact, bridge, SLR)	**Product line length**						
DV: customer evaluations	Model A1	Model A2	Model A3	Model A4	Model A5	Model A6	Model A7
Product line length (PLL)		.001 (.001)	.002** (.001)	4.12E-4 (.001)	.001* (.001)	.002** (.001)	.002** (.001)
Product line length squared (PLL^2)			-8.178E-5*** (.000)			-8.295E-5*** (.000)	-8.430E-5*** (.000)
Competitive intensity (CI)				-.005 (.003)	.002 (.004)	-.001 (.003)	-.001 (.003)
PLL x CI					-2.59E-4*** (.000)		
PLL^2 x CI							-2.821E-7 (.000)
Megapixels	.010** (.003)	.009** (.003)	.009** (.003)	.011** (.003)	.009** (.003)	.012*** (.003)	.012*** (.003)
Sensor size	4.52E-4*** (.000)	4.60E-4*** (.000)	4.11E-4*** (.000)	4.34E-4*** (.000)	4.60E-4*** (.000)	3.65E-4*** (.000)	3.64E-4*** (.000)
Firm age	-.003*** (.001)	-.003*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)
Firm size	-7.028E-7* (.000)	-7.196E-7** (.000)	-8.429E-7** (.000)	-7.972E-7** (.000)	-6.445E-7* (.000)	-1.003E-6*** (.000)	-1.014E-6*** (.000)
Firm tenure	-.013** (.004)	-.015** (.004)	-.014** (.004)	-.015** (.004)	-.014** (.004)	-.016*** (.004)	-.016*** (.004)
Industry firm density	-.008*** (.002)	-.008*** (.002)	-.006*** (.002)	-.007*** (.002)	-.006*** (.002)	-.006*** (.002)	-.006*** (.002)
Industry product density	-2.34E-4*** (.000)	-2.74E-4*** (.000)	-3.14E-4*** (.000)	-2.622E-5 (.000)	-3.32E-4* (.000)	-2.71E-4* (.000)	-2.73E-4* (.000)
R^2	28.4	28.5	29.4	28.1	28.9	30.4	30.4
F	81.09	72.27	67.94	63.51	60.15	64.59	59.18

Notes: Standard errors in parentheses.

***p <.001; **p <.01; *p <.05

All of the models are statistically significant at the $p < .001$ level. According to the R^2 values, the predictive power of the models varies from between 28.1 percent and 30.4 percent. Of this, 28.4 percent is explained by the control variables depicted in model A1.The quantity of megapixels has a positive and significant coefficient ($\beta = .010$, $p < .01$), and sensor size a very slightly positive, but statistically significant one ($\beta = .000$, $p < .001$). All the other control variables, firm age, firm size, firm

tenure, industry firm density, and industry product density have negative, yet statistically significant coefficients.

Product line length assumes slightly positive, statistically significant values in each of the squared models of A3, A6, and A7 ($\beta = .002$, $p < .01$), and for these models, the explanatory power is also increased by 1.0 percent to 29.4 percent for model A3, and by 2.0 percent to 30.4 percent for models A6 and A7. In these models, the squared term of product line length is also statistically significant, with values very close to 0, although still a touch on the negative side ($\beta = -.000$, $p < .001$). Model A5 seems to lend support to linear moderation, as both product line length and the interaction term of product line length and competitive intensity assume statistically significant values, product line length a positive one and the interaction term a negative one ($\beta = .001$, $p < .05$; $\beta = -.000$, $p < .001$). Competitive intensity itself does not have statistically significant coefficients, and similarly, the interaction term of product line length squared and competitive intensity is not statistically significant.

Table 7 presents the results of the same models, but for the compact digital camera category only. All of the models are statistically significant at the $p = .000$ level. According to the R^2 values, the predictive power of the models varies from between 10.9 percent and 15.3 percent. Of this, 10.9 percent is explained by the control variables depicted in model C1. Of the control variables, firm age, firm tenure, and industry firm density have slightly negative, statistically significant coefficients, and sensor size a positive and significant one ($\beta = .004$, $p < .01$).

Table 7. Results of the regression models on the relationship between product line length and customer evaluations for compact digital cameras; unstandardized beta coefficients.

Compacts	**Product line length**						
DV: customer evaluations	Model C1	Model C2	Model C3	Model C4	Model C5	Model C6	Model C7
Product line length (PLL)		-.002** (.001)	.001 (.001)	-.001 (.001)	3.25E-4 (.001)	.002* (.001)	.002 (.001)
Product line length squared (PLL^2)			-1.25E-4*** (.00)			-1.42E-4*** (.00)	-1.49E-4*** (.00)
Competitive intensity (CI)				-.003 (.002)	-.007** (.002)	-.007** (.002)	-.008** (.002)
PLL x CI					-3.94E-4*** (.00)		
PLL^2 x CI							4.182E-6 (.000)
Megapixels	.008 (.005)	.008 (.005)	.010* (.005)	.007 (.005)	.009 (.005)	.007 (.005)	.007 (.005)
Sensor size	.004** (.001)	.003** (.001)	.004*** (.001)	.004** (.001)	.004*** (.001)	.004** (.001)	.004** (.001)
Firm age	-.003*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)
Firm size	-2.466E-7 (.000)	8.183E-8 (.000)	-1.182E-8 (.000)	-2.202E-7 (.000)	-1.457E-7 (.000)	-1.682E-7 (.000)	-2.146E-7 (.000)
Firm tenure	-.018** (.005)	-.011* (.006)	-.011* (.005)	-.015** (.005)	-.017** (.005)	-.014* (.006)	-.015** (.006)
Industry firm density	-.006** (.002)	-.007** (.002)	-.003 (.002)	-.008*** (.002)	-.006** (.002)	-.005* (.002)	-.005* (.002)
R^2	10.9	11.7	14.9	12.2	13.5	15.2	15.3
F	21.17	20.11	23.43	18.54	18.76	21.66	19.84

Notes: Standard errors in parentheses.

***p<.001; **p<.01; *p<.05

The squared term of product line length has a statistically significant, negative coefficient very close to 0 (β = -.000, p < .001) in models C3, C6 and C7. Product line length assumes a slightly negative value in model C2 (β = -.002, p < .01), and a slightly positive one in C6 (β = .002, p < .05). Competitive intensity has a negative and statistically significant coefficients in each of the models where it is tested, except for C4. The interaction term of product line length and competitive intensity has a statistically significant, negative coefficient close to zero (β = -.000, p < .001). The inclusion of the squared term of product line length has the most positive effect on the explanatory power of the models, as models C3, C6, and C7 have the highest values of R2: 14.9, 15.2, and 15.3 percent, respectively.

The results of the regressions on the digital cameras classified as belonging to the bridge category are presented in Table 8. All of the models are statistically significant at the $p = .000$ level. According to the R^2 values, the predictive power of the models varies from between 15.2 percent and 18.6 percent. Of this, 15.2 percent is explained by the control variables depicted in model B1. The quantity of megapixels has a positive and significant coefficient ($\beta = .014$, $p < .05$), and firm size a negative one very close to zero ($\beta = -.000$, $p < .01$). None of the independent variables experience statistically significant values in this category, though the linear moderation model B5 has the highest predictive power, independent variables of product line length, competitive intensity, and the interaction term adding an additional 3.4 percent to the baseline model.

Table 8. Results of the regression models on the relationship between product line length and customer evaluations for digital cameras in the bridge product category; unstandardized beta coefficients.

Bridge	**Product line length**						
DV: customer evaluations	Model B1	Model B2	Model B3	Model B4	Model B5	Model B6	Model B7
Product line length (PLL)		-.005 (.004)	-.008 (.005)	-.001 (.005)	-.003 (.005)	-.004 (.006)	-.006 (.006)
Product line length squared (PLL^2)			.001 (.001)			4.34E-4 (.001)	-3.16E-4 (.001)
Competitive intensity (CI)				-.030 (.019)	-.028 (.020)	-.025 (.020)	-.045 (.023)
PLL x CI					.002 (.003)		
PLL^2 x CI							.001 (.000)
Megapixels	.014* (.005)	.014** (.005)	.014** (.005)	.013*(.005)	.013**(.005)	.014** (.005)	.015** (.005)
Sensor size	2.812E-5 (.000)	3.099E-5 (.000)	3.641E-6 (.000)	-1.912E-5 (.000)	-1.683E-5 (.000)	-9.357E-5 (.000)	-9.517E-5 (.000)
Firm age	-.003 (.001)	-.003* (.001)	-.003 (.001)	-.003* (.001)	-.003* (.001)	-.003 (.001)	-.003* (.001)
Firm size	-1.553E-6** (.000)	-1.474E-6** (.000)	-1.511E-6** (.000)	-1.530E-6** (.000)	-1.456E-6** (.000)	-1.286E-6** (.000)	-1.319E-6** (.000)
Firm tenure	-.015 (.009)	-.011 (.009)	-.011 (.009)	-.013 (.009)	-.012 (.009)	-.010 (.009)	-.011 (.009)
Industry firm density	-.007 (.005)	-.007 (.005)	-.007 (.004)	-.009 (.004)	-.009* (.005)	-.006 (.004)	-.005 (.004)
R^2	15.2	15.7	17.6	18.4	18.6	15.3	16.1
F	6.35	5.76	5.79	6.09	5.55	4.41	4.23

Notes: Standard errors in parentheses.
***p<.001; **p<.01; *p<.05

Table 9 includes the results for digital SLR's. All of the models are statistically significant at the p =.000 –level. According to the R2-values, the predictive power

of the models varies from 50.0 percent to 52.5 percent. Of this, 52.4 percent is explained by the control variables depicted in model S1. The quantity of megapixels, firm tenure, and industry product density all have slightly positive and statistically significant coefficients. Firm age and sensor size have a negative one (β = -.005, p < .05; β = -.000, p < .001).

Table 9. Results of the regression models on the relationship between product line length and customer evaluations for digital SLRs; unstandardized beta coefficients.

SLRs	**Product line length**						
DV: customer evaluations	Model S1	Model S2	Model S3	Model S4	Model S5	Model S6	Model S7
Product line length (PLL)		.002 (.004)	.006 (.004)	.000 (.004)	.001 (.004)	.006 (.004)	.006 (.004)
Product line length squared (PLL^2)			-3.80E-4 (.000)			-4.48E-4 (.000)	-4.43E-4 (.000)
Competitive intensity (CI)				-.041 (.004)	-.040 (.062)	-.011 (.060)	-.029 (.077)
PLL x CI					-.002 (.005)		
PLL^2 x CI							1.87E-4 (.000)
Megapixels	.011** (.004)	.011** (.004)	.010** (.004)	.009* (.004)	.009* (.004)	.011** (.004)	.011** (.004)
Sensor size	-4.42E-4*** (.000)	-4.36E-4*** (.000)	-3.57E-4*** (.000)	-3.49E-4*** (.000)	-3.51E-4*** (.000)	-3.43E-4*** (.000)	-3.45E-4*** (.000)
Firm age	-.005* (.002)	-.004 (.003)	-.003 (.002)	-.005* (.002)	-.005* (.002)	-.003 (.002)	-.003 (.002)
Firm size	-1.394E-6 (.000)	-1.317E-6 (.000)	-2.487E-7 (.000)	-1.111E-6 (.000)	-1.198E-6 (.000)	-4.428E-7 (.000)	-4.619E-7 (.000)
Firm tenure	.024** (.008)	.022* (.010)	.025** (.009)	.025** (.009)	.024** (.009)	.021* (.009)	.022* (.009)
Industry product density	.003* (.001)	.003* (.001)	.001 (.001)	.004 (.002)	.004 (.002)	.002 (.002)	.002 (.002)
R^2	52.4	52.5	50.0	50.7	50.8	50.9	50.9
F	23.94	20.87	17.08	17.62	15.80	15.63	14.14

Notes: Standard errors in parentheses.
***p <.001; **p <.01; *p <.05

Similar to the bridge category, the independent variables do not assume statistically significant values, and their inclusion in fact weakens the explanatory power of models S3–S7. In model S2, the addition of product line length adds 0.1 percent to the R^2 value.

4.3 The relationship between product line breadth and performance and the moderating effect of competitive intensity

This chapter presents the hierarchical multiple regression and the moderated hierarchical multiple regression results of the models analyzing hypotheses 2a and 2b, concerning the relationship between product line breadth and customer evaluations as well as the moderating effect of competitive intensity on this relationship in all of the product categories combined and in each of them separately. As depicted in Table 4, models 8–10 involve hypothesis 2a, whereas models 11–14 involve hypothesis 2b. Table 10 presents the results for the entire industry.

Table 10. Results of the regression models on the relationship between product line breadth and customer evaluations for all product categories; unstandardized beta coefficients.

All categories (compact, bridge, SLR)	**Product line breadth**						
DV: customer evaluations	Model A8	Model A9	Model A10	Model A11	Model A12	Model A13	Model A14
Product line breadth (PLB)		.051** (.018)	.016 (.019)	.060** (.017)	.050** (.018)	.025 (.019)	.017 (.020)
Product line breadth squared (PLB^2)			-.157***(.025)			-.142*** (.025)	-.099* (.041)
Competitive intensity (CI)				-.007* (.003)	.002 (.004)	-.003 (.003)	-.006 (.004)
PLB x CI					-.012*** (.003)		
PLB^2 x CI							.009 (.007)
Megapixels	.009** (.003)	.008* (.003)	.010** (.003)	.009** (.003)	.008* (.003)	.011** (.003)	.012** (.003)
Sensor size	4.48E-4*** (.000)	4.49E-4*** (.000)	3.93E-4*** (.000)	4.23E-4*** (.000)	4.18E-4*** (.000)	3.76E-4*** (.000)	3.71E-4*** (.000)
Firm age	-.003*** (.002)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)	-.004*** (.001)
Firm size	-6.407E-7* (.000)	-5.487E-7* (.000)	-7.908E-7** (.000)	-5.706E-7* (.000)	-7.180E-7** (.000)	-8.086E-7** (.000)	-7.854E-7** (.000)
Firm tenure	-.014** (.004)	-.015*** (.004)	-.023*** (.004)	-.015*** (.004)	-.019*** (.004)	-.022*** (.004)	-.022*** (.004)
Industry firm density	-.008***(.002)	-.008***(.002)	-.009***(.002)	-.007***(.002)	-.007***(.002)	-.008***(.002)	-.008***(.002)
Industry product density	-2.31E-4*** (.000)	-2.62E-4*** (.000)	-3.07E-4*** (.000)	1.765E-5 (.000)	-1.94E-4 (.000)	-1.75E-4 (.000)	-1.79E-4 (.000)
R^2	27.3	27.6	29.4	28.7	29.5	29.4	29.5
F	76.52	69.20	67.80	65.55	61.73	61.48	56.53

Notes: Standard errors in parentheses.

***p <.001; **p <.01; *p <.05

All of the models are statistically significant at the p = .000 –level. According to the R2 -values, the predictive power of the models varies from 27.3 percent to 29.5 percent. Of this, 27.3 percent is explained by the control variables depicted in model A8. The quantity of megapixels has a positive and significant coefficient (β = .009, p < .01), and sensor size a very slightly positive, but statistically significant one (β = .000, p < .001). All the other control variables—firm age, firm size, firm tenure, industry firm density, and industry product density—have negative, yet statistically significant coefficients.

.

In the linear models A9, A11, and A12, product line breadth has a statistically significant, positive coefficient (β = .051, p < .01; β = .060, p < .01; and β = .050, p

< .01, respectively). In the squared models A10, A13, and A14, the squared term of product line breadth is significant and negative (β = -.157, p < .001; β = -.142, p < .001; and β = -.099, p < .05, respectively), whereas the linear term of product line length does not assume statistically significant values.

Competitive intensity has a slightly negative, statistically significant coefficient in model A11 (β = -.007, p < .05), and the interaction term of product line length and competitive intensity is significant in the linear moderation model A12 (β = -.012, p < .001). There is no significant interaction effect in the squared moderation model A14, and competitive intensity itself is not statistically significant in any of the other models where it is included (A12–A14). Adding independent variables to the models improved the explanatory power of the models by over 2 percent in models A10, A12, A13, and A14, for example.

Table 11 presents the results of the regression models for the compact digital camera category. All of the models are statistically significant at the p = .000 level. According to the R^2 values, the predictive power of the models varies from between 10.2 percent and 16.1 percent. Of this, 10.2 percent is explained by the control variables depicted in model C8. Of the control variables, firm age, firm tenure, and industry firm density have slightly negative, statistically significant coefficients, and sensor size a positive and significant one (β = .004, p < .01).

Table 11. Results of the regression models on the relationship between product line breadth and customer evaluations for compact digital cameras; unstandardized beta coefficients.

Compacts	**Product line breadth**						
DV: customer evaluations	Model C8	Model C9	Model C10	Model C11	Model C12	Model C13	Model C14
Product line breadth (PLB)		.047* (.021)	.017 (.021)	.058** (.020)	.064** (.020)	.031 (.021)	.032 (.021)
Product line breadth squared (PLB^2)			-.159*** (.026)			-.170*** (.026)	-.172*** (.028)
Competitive intensity (CI)				-.006** (.002)	-.002 (.002)	-.008*** (.002)	-.007** (.003)
PLB x CI					-.020*** (.003)		
PLB^2 x CI							-.001 (.004)
Megapixels	.008 (.005)	.007 (.005)	.010 (.005)	.002 (.005)	.004 (.005)	.003 (.005)	.002 (.005)
Sensor size	.004** (.001)	.004** (.001)	.004** (.001)	.004** (.001)	.003* (.001)	.004*** (.001)	.004*** (.001)
Firm age	-.003*** (.001)	-.003*** (.001)	-.004*** (.001)	-.003*** (.001)	-.004*** (.001)	-.003*** (.001)	-.003*** (.001)
Firm size	-2.844E-7 (.000)	-2.437E-7 (.000)	-4.685E-7 (.000)	-2.546E-8 (.000)	1.395E-7 (.000)	-3.762E-7 (.000)	-3.675E-7 (.000)
Firm tenure	-.018** (.005)	-.020*** (.005)	-.025*** (.005)	-.020*** (.005)	-.021*** (.005)	-.028*** (.005)	-.028*** (.005)
Industry firm density	-.006** (.002)	-.006** (.002)	-.007** (.002)	-.009*** (.002)	-.006** (.002)	-.011*** (.002)	-.011*** (.002)
R^2	10.2	10.5	13.6	12.2	16.1	15.1	15.1
F	19.66	17.90	21.22	18.78	23.31	21.49	19.52

Notes: Standard errors in parentheses.
***p < .001; **p < .01; *p < .05

In the linear models C9, C11, and C12, product line breadth has a statistically significant, positive coefficient (β = .047, p < .05; β = .058, p < .01; and β = .064, p < .01, respectively). In the squared models C10, C13, and C14, the squared term of

product line breadth is significant and negative (β = -.159, p < .001; β = -.170, p < .001; and β = -.172, p < .001, respectively), whereas the linear term of product line length does not assume statistically significant values.

Competitive intensity has a slightly negative statistically significant coefficient in models C11, C13, and C14 (β = -.006, p < .01; β = -.008, p < .001; and β = -.007, p < .01, respectively), and the interaction term of product line length and competitive intensity is significant in the linear moderation model C12 (β = -.020, p < .001). There is no significant interaction effect in the squared moderation model C14. Adding independent variables to the models improved the explanatory power of the models by almost 6 percent in model C12, the linear moderation model, and by almost 5 percent in models C13 and C14, which had the squared term of product line breadth.

Table 12 includes the results for the bridge category. All of the models are statistically significant at the p = .000 level. According to the R^2 values, the predictive power of the models varies from between 13.1 percent and 18.7 percent. Of this, 17.1 percent is explained by the control variables depicted in model B8. The quantity of megapixels has a positive and significant coefficient (β = .014, p < .05) and firm size a negative one that is very close to zero (β = -.000, p < .001).

Table 12. Results of the regression models on the relationship between product line breadth and customer evaluations for digital cameras in the bridge product category; unstandardized beta coefficients.

Bridge	**Product line breadth**						
DV: customer evaluations	Model B8	Model B9	Model B10	Model B11	Model B12	Model B13	Model B14
Product line breadth (PLB)		-.057 (.043)	-	-.072 (.042)	-.070 (.042)	-	-
Product line breadth squared (PLB^2)			-.005 (.010)			-.014 (.009)	-.011 (.009)
Competitive intensity (CI)				-.035* (.016)	-.038* (.016)	-.034* (.016)	-.002 (.027)
PLB x CI					.041 (.029)		
PLB^2 x CI							-.146 (.097)
Megapixels	.014* (.005)	.013* (.005)	.011 (.006)	.014** (.005)	.014* (.005)	.014** (.005)	.012* (.005)
Sensor size	5.461E-5 (.000)	6.272E-5 (.000)	9.105E-5 (.000)	1.211E-5 (.000)	1.029E-5 (.000)	-1.206E-5 (.000)	7.055E-6 (.000)
Firm age	-.003 (.001)	-.003* (.001)	-.002 (.001)	-.003 (.001)	-.003 (.001)	-.003 (.001)	-.002 (.001)
Firm size	-1.681E-6*** (.000)	-1.876E-6*** (.000)	-1.517E-6** (.000)	-1.713E-6*** (.000)	-1.406E-6** (.000)	-1.741E-6*** (.000)	-1.279E-6* (.000)
Firm tenure	-.015 (.008)	-.018* (.009)	-.012 (.010)	-.015 (.009)	-.011 (.009)	-.016 (.009)	-.010 (.009)
Industry firm density	-.007 (.004)	-.008 (.004)	-.006 (.005)	-.008 (.005)	-.007 (.005)	-.008 (.004)	-.007 (.005)
R^2	17.1	17.7	13.1	17.9	18.5	17.9	18.7
F	7.30	6.63	4.59	5.83	5.46	5.92	5.59

Notes: Standard errors in parentheses.
***p<.001; **p<.01; *p<.05

Neither product line breadth nor the squared term of product line breadth assumes a statistically significant value. Competitive intensity is significant and negative in models B11–B13 (β = -.035, p < .05; β = -.038, p < .05; and β = -.034, p < .05, respectively), but there are no significant interaction effects in the moderation models B12 and B14. Yet, the squared moderation model has the highest predictive power, adding 1.6 percent to the baseline model. In analyzing the bridge category,

the squared term of product line breadth and the linear term experienced significant multicollinearity that was not corrected by the centering of the variables, as the sample size was smaller than in the previous analyses. For models B10, B13, and B14, the linear term of product line breadth had to be removed from the analyses to correct the issue with multicollinearity.

The regression results for the digital SLR category are presented in Table 13. All of the models are statistically significant at the $p = .000$ –level. According to the R^2-values, the predictive power of the models varies from 48.0 percent to 51.0 percent. Of this, 51.0 percent is explained by the control variables depicted in model S8. The quantity of megapixels, firm tenure, and industry product density all have slightly positive and statistically significant coefficients. Firm age and sensor size have a negative one ($\beta = -.004$, $p < .05$; $\beta = -.000$, $p < .001$).

Table 13. Results of the regression models on the relationship between product line breadth and customer evaluations for digital SLRs; unstandardized beta coefficients.

SLRs	**Product line breadth**						
DV: customer evaluations	Model S8	Model S9	Model S10	Model S11	Model S12	Model S13	Model S14
Product line breadth (PLB)		-.015 (.061)	-	-.050 (.068)	-.053 (.069)	-	-
Product line breadth squared (PLB^2)			-.076 (.306)			-.252 (.340)	-.264 (.343)
Competitive intensity (CI)				-.043 (.065)	-.050 (.070)	-.043 (.065)	-
PLB x CI					.029 (.089)		
PLB^2 x CI							-
Megapixels	.011** (.004)	.011** (.004)	.011** (.004)	.009* (.004)	.009* (.004)	.009* (.004)	.009* (.004)
Sensor size	-4.27E-4*** (.000)	-4.29E-4*** (.000)	-4.29E-4*** (.000)	-3.36E-4*** (.000)	-3.33E-4*** (.000)	-3.36E-4*** (.000)	-3.33E-4*** (.000)
Firm age	-.004* (.002)	-.004* (.002)	-.004* (.002)	-.004 (.002)	-.004 (.002)	-.004 (.002)	-.004 (.002)
Firm size	-1.305E-6 (.000)	-1.266E-6 (.000)	-1.266E-6 (.000)	-1.027E-6 (.000)	-9.550E-7 (.000)	-1.027E-6 (.000)	-9.550E-7 (.000)
Firm tenure	.024** (.007)	.024** (.007)	.024** (.007)	.024** (.008)	.024** (.008)	.024** (.008)	.024** (.008)
Industry product density	.003* (.001)	.003* (.001)	.003* (.001)	.005* (.002)	.005* (.002)	.005* (.002)	.005* (.002)
R^2	51.0	51.0	51.0	48.0	48.0	48.0	48.0
F	22.75	19.79	19.79	15.67	14.03	15.67	14.03

Notes: Standard errors in parentheses.
***p <.001; **p <.01; *p <.05

The independent variables do not assume any statistically significant values, and their inclusion in fact weakens the explanatory power of models S11–S14. In models S9 and S10, the addition of product line breadth or product line breadth squared does not weaken the model, but it does not add to the R^2 value, either. Similar to the bridge category, the squared and linear terms of product line breadth experienced significant multicollinearity that was not corrected by the centering of the variables, since the sample size was smaller than in the previous analyses. For models S10, S13, and S14, the linear term of product line breadth had to be removed from the analyses to correct the issue with multicollinearity. The basis for this is discussed in more detail in the following section.

4.4 Discussion of the results

The objectives of the study were to analyze the relationships between product line length and firm performance and product line breadth and firm performance and investigate the effect of competitive intensity on both of these relationships. Three product lines of compact, bridge, and SLR cameras were distinguished from the digital camera market, and analyses were performed on each of them separately and on the entire market as a whole. The analysis of the entire camera market follows the procedure adopted in most product line studies, where no distinction between different product categories of the market is made, and the market is analyzed as an entity. The analyses of this study provide a more detailed perspective, as product line strategies are also analyzed separately for each product category. The data was analyzed based on the four research questions outlined in Chapter 1, section 1.2. Table 14 presents the questions and the main findings related to them.

Table 14. Main findings of the study.

Research questions		Main findings			
		Digital camera market	Compact cameras	Bridge cameras	SLRs
RQ1	*Is there a relationship between a firm's product line length and its performance, and if so, what kind of relationship?*	Inverted U-shaped relationship[1]	Inverted U-shaped relationship[1]	No effect	No effect
RQ2	*Is there a relationship between a firm's product line breadth and its performance, and if so, what kind of relationship?*	Inverted U-shaped relationship[2]	Inverted U-shaped relationship[2]	No effect	No effect
RQ3	*Does competitive intensity have an effect on the relationship between product line length and firm performance?*	Linear moderation	Linear moderation	No effect	No effect
RQ4	*Does competitive intensity have an effect on the relationship between product line breadth and firm performance?*	Linear moderation	Linear moderation	No effect	No effect

[1] However, this was eventually interpreted as a negative linear relationship, as explained in more detail in the following sections.

[2] However, this was eventually interpreted as a negative linear relationship, as explained in more detail in the following sections.

Overall, in terms of the entire industry and compact product category, the quadratic model seems to outperform the linear model in the analyses on both length and breadth. The predictive power of the models is significantly improved and the coefficients are statistically significant in these analyses.

4.4.1 Product line length

In terms of the first research question, this study hypothesized that there would be an inverted U-shaped relationship between the variables of product line length and firm performance. The data on the market as a whole and on the compact product category seem to lend support to this. For the data on the market as a whole, both the linear and squared terms assume statistically significant values in the quadratic

models. In the compact category, the squared terms have negative and statistically significant values, but the values of the linear terms are mostly not significant, though they remain positive. In all, the coefficients of the linear terms take slightly positive values in the quadratic models, implying that, at least to a certain point, increasing the length of a product line might be associated with improved firm performance, but overly extending the product line might not be a beneficial strategy. This might be due to a number of risks that the previous literature has identified related to long product lines, such as increased organizational, production, and logistics complexity resulting in rising costs (Quelch and Kenny 1994; Anderson 1995; Boulding and Christen 2009), weaker product performance due to limited development resources for one product (Sorenson 2000), cannibalization (Barroso and Giarratana 2013; Wilson and Norton 1989; Moorthy and Png 1992; Axarloglou 2008), and preference uncertainty (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992). The finding is also supported by a number of recent contributions to the field (Giarratana and Fosfuri 2007; Barroso and Giarratana 2013; Jeong et al. 2017; Gang et al. 2018).

As a large quantity of new product variants are added to the firm's product line, the complexity of the production is often bound to rise, potentially resulting in diseconomies of scale (Putsis 1997). The management of increased complexity in production, organization, and logistics may cause additional costs that are in turn converted into higher prices, lowering the demand of the firm's products (Bayus and Putsis 1999). This might lower the customers' satisfaction with the products, as the quality they receive for the price they pay is lower than previously. Similarly, as the firm is forced to divide its resources among the products of a longer product line, the quality of the products might suffer (Sorenson 2000). Products that are part of a very long product line might also bear too much of a resemblance with each other, and end up cannibalizing each other's sales (Barroso and Giarratana 2013; Wilson and Norton 1989; Moorthy and Png 1992; Axarloglou 2008).

The implication that length is beneficial up to a certain point is supported by the proposition that a longer product line allows the firm to cater to a wider range of customer needs and respond to changes in them (Lancaster 1990; Shapiro and Varian 1998; Moreno and Terwiesch 2017). The efficiency of the firm's operations and the quality of its products may also improve as a result of learning effects, when new variants are added to an existing product line (Kim and Kogut 1996; Kogut and Zander 1992; Smith et al. 2005; Eggers 2012).

For bridge and SLR product lines, the variables of length and breadth assumed no statistically significant values, although the predictive power of the model

increased by nearly 2 percent for the bridge category analysis on product line length when the quadratic term was added. This could be caused by differences in the dynamics of each product category. The product categories in the digital camera market can be deemed quite different from each other with for example firm density, product density, and barriers to entry varying significantly between each of them, and especially between compact cameras and the other two categories. As such, it is an expected outcome that they should experience different dynamics also in terms of the effectiveness of utilizing product line strategies and the effects of competitive intensity (e.g. Gang et al. 2018). In the case of compact cameras, the category has traditionally had a high density of both products and firms, and the barriers to entry are deemed quite low as opposed to the more high-end categories, also contributing to the higher density of firms. The category has witnessed intense competition on both price and quality attributes, and firms have extended their product lines in an attempt to cater for the diverse customer needs and maximize their market shares.

Compared to compact cameras, bridge and SLR cameras have a significantly more homogeneous customer base, lower firm density, lower product density, lower intensity of new product introductions, higher prices, and higher barriers to entry due to higher technical performance requirements and R&D investments, for example. Previous research has recognized these factors as potentially affecting both the strength and direction of the performance effects of product line decisions (e.g., Kekre and Srinivasan 1990; Giarratana and Fosfuri 2007; Giachetti and Dagnino 2014; Gang et al. 2018). Interestingly, based on the results and specifically the insignificant relationships between performance and product line length decisions in the bridge and SLR categories as opposed to the significant ones in the compact category, it seems that product line actions might not be a profitable strategy for firms to use to cope with changes in the competitive environment in these categories, as previously posited by researchers (Bayus and Putsis 1999; Barroso and Giarratana 2013; Jeong et al. 2017). However, in the compact category, this type of competitive maneuvering as suggested by the competitive dynamics view, would seem more beneficial for the firm.

Though some of the previous studies have taken into account the aspect of product line breadth in the sense that there are multiple product categories inside a particular submarket (Giarratana and Fosfuri 2007; Barroso and Giarratana 2013), they have not analyzed the effects of length or breadth in each of them separately, but instead still dealt with the market as a whole as their level of analysis. In these studies, the utilized product line length measures consider only the product line length of a firm in the product category with the highest density of products by the

same firm (Barroso and Giarratana 2013; Dowell 2006), or the cumulative number of new versions of the product with which the firm first entered the market (Giarratana and Fosfuri 2007). This study expands on these previous views, distinguishing three separate product categories and analyzing the effects of different product line strategies in each of them separately, and in the more traditional sense, in the market as a whole. The results appear largely similar for the market as a whole and for the compact product category, which is not surprising considering the compact category makes up most of the product line actions in the market. For this reason, studies analyzing the entire submarket and not distinguishing between product categories are prone to get results following the dynamics of the largest, most intensive, or otherwise most influential product category. This type of an approach might thus ignore important differences among the categories, and generalize the findings of one product category as applicable to the market as a whole.

To answer the first research question, product line length is correlated with firm performance in the market as a whole and in the compact product category in particular, but not in the bridge or SLR categories. The results imply that in the compact category and in the market as a whole firms with moderately adjusted product line lengths fare better than those with very short or very long ones.

The third research question adds competitive intensity into considerations on product line length decisions. To study the question, it was hypothesized that competitive intensity strengthens the relationship between product line length and firm performance. In terms of the quadratic models, the interaction term of competitive intensity has no significant effect, but a slightly negative moderation effect is present in the linear models on compact cameras and the market as a whole. This results in a situation where an increase in the level of competitive intensity, in effect, turns the former positive linear relationship between product line length and firm performance into a negative one. As the quadratic models imply an inverted U-shaped relationship, where excessive length of the product line has adverse effects, in an environment of high competitive intensity, a very long product line is even more detrimental to firm performance.

The effect of competitive intensity might be based on the challenges a very long product line poses under circumstances of intense competition in terms of coordination and decision-making. In these types of situations, firms benefit from the ability to react to rivals' competitive actions in a flexible and timely manner, which is exacerbated by extensive variety in the firm's product line (Draganska and Jain 2005), slowing down its decision-making speed (Jones 2003).

Especially in a product category such as the compact cameras that has been characterized by high competitive intensity and firm and product density, customers may experience decision conflict and uncertainty in their preferences, as the variety offered by firms is so extensive (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992). Increased competitive intensity might result in the customers feeling less satisfied with their eventual selection, and more likely to feel disappointed or even regret it (Simonson 1990; Iyengar and Lepper 2000; Schwartz 2000). In addition, as firms lengthen their product lines, they might not able to focus as much resources on a particular product as previously, which could lower the quality of their products, further lowering the satisfaction of the customers on them (Sorenson 2000). These are all factors that could be reflected in the firm performance measure of this study, as customer evaluations are intended to capture the satisfaction of the customers on the products of the firm.

Combined with the previous considerations, the results imply that for the market as a whole and for the compact product category, firms with very long product lines perform worse than those with moderate ones, and the effect of the difference in length is bolstered by intensified competition, that is, firms with long product lines do even worse when the intensity of competition rises.

In light of previous research, the finding that competitive intensity strengthens the relationship between product line length and firm performance is to be expected (e.g., Giachetti and Dagnino 2014; Jeong et al. 2017; Gang et al. 2018). The competitive dynamics view argues that intensified competition urges firms to defend their positions in the market through new competitive actions, such as product line actions, as the resources they have invested in the market, their market shares, and profits are threatened (Ferrier et al. 2002; Jeong et al. 2017).

But what then is a moderately adjusted product line? When the first derivative of the squared model is set equal to zero, it is possible to observe the point at which the relationship between the variables turns from positive to negative. For the entire market, this happens when the product line length of firms equals 12.2 products, and for the compact category at four products. As the mean value of product line length is around 45 products, most of the firms are actually operating at product line length levels that experience negative correlation with firm performance. Thus, it would in fact seem that the relationship between product line length and firm performance is negative. Lengthening the product line is hence associated with weaker performance in both the market as a whole and in the compact category.

4.4.2 Product line breadth

Regarding the second research question, a U-shaped relationship between product line breadth and firm performance was hypothesized. However, contrary to expectations, the data presents an inverted U-shaped relationship, indicating that firms with product lines of average breadth actually tend to outperform those with very narrow or very broad product lines. This relationship is found in the digital camera market as a whole and in the compact product category in particular, but again, it is not found in the bridge or SLR categories.

Previous research on the product line breadth–firm performance relationship is scarce in the field of strategic management, but in other streams of research the U-shaped relationship has been attributed to economies of scope, for example (Rumelt 1982; Helfat and Eisenhardt 2004; Li and Greenwood 2004), in that a firm can base the development of new products on the common and recurrent use of proprietary knowhow and specialized and indivisible physical assets (Teece 1980), benefitting from the efficiencies incurred by this practice and the overall use of shared resources between product variants (Farjoun and Lai 1997; Gary 2005; Miller 2006). The U-shaped relationship has also been linked to increased customer loyalty, as customer search costs are minimized when a broader set of needs is met by one particular brand (Sappington and Wernerfelt 1985; Giarratana and Fosfuri 2007; Ye et al. 2012). Indeed, customers in technology markets have been found to appreciate a variety of products offered by a single vendor (Cottrell and Nault 2004). From the competitive dynamics view, the mutual forbearance hypothesis also lends support to the benefits of increased breadth, as firms that meet in multiple markets are deemed to compete less aggressively against one another (Gimeno and Woo 1999).

The unanticipated outcome of the analyses does, however, have theoretical footing. The broadening of the product line often requires new routines, employees, and organizational capabilities, and their acquisition may interrupt and change networks and communications within the firm (Tushman and Anderson 1986; Henderson and Clark 1990). Thus, entering new product categories has the potential to disrupt firm operations. In the case of the digital camera market, this is even quite probable, as the differences in technical knowhow, customer base, and brand relevance differ significantly between the compact and SLR product categories, for example, placing high demands on a firm seeking to broaden its product line from compact cameras to SLRs. Additionally, as new product categories require employees to learn new routines and tasks, there is the potential for negative transfer, where proven practices are followed even in the case of a new task, resulting in poor

performance (Novick 1988; Zahavi and Lavie 2013). Following the population ecology view, a generalist strategy denoting a broad product line might have adverse effects, such as receiving less attention and legitimacy in the market, which result in lower chances of survival and success (Dobrev et al. 2001; Zuckerman 1999; Hsu et al. 2009). Likewise, the mutual forbearance hypothesis can be questioned, as multimarket contact might result in more intensified competition and more limited growth and survival possibilities because the firms have similar knowledge and resource bases for which they need to compete (Hannan and Freeman 1977; Dowell 2006).

The lower performance of firms with narrow product lines might be attributed to learning effects that accrue in firms that broaden their product lines and through that experience gain management and operational efficiency, which enables better quality new product introductions (Kim and Kogut 1996; Smith et al. 2005; Eggers 2012). Firms with a very narrow scope might also suffer from a very narrow resource base. These limits on firms' resources may inhibit or create ineffectiveness in their competitive actions, resulting in lower performance (Lamberg et al. 2009).

In terms of the fourth research question, it was hypothesized that competitive intensity strengthens the relationship between product line breadth and firm performance. The hypothesis receives partial support from the evidence. The moderating effect of competitive intensity is noted only for the linear model, where the increase in competitive intensity seems to in fact turn the relationship from the previously detected positive one into a negative one. The moderation effect registered in the entire camera market and in the compact product category suggests that when competitive intensity is taken into account, product line breadth negatively affects the performance of the firm. In addition, competitive intensity seems to strengthen the effect, so that under conditions of high competitive intensity, a very broad product line is even more detrimental to performance than it would be under low or moderate levels of competition. This relationship may be partially explained by the coordination and resource challenges that very broad product lines pose. Under conditions of intensified competition, it is vital for firms to be able to respond quickly and effectively to their rivals' actions. A very broad product line forces a firm to split its resources between multiple product categories and slows down its decision-making speed (Jones 2003) at a time when the ability to flexibly and rapidly react to rivals' competitive actions is vital to a firm's performance and survival (Draganska and Jain 2005).

Prior research has argued that these problems might be tackled through learning by doing, but in light of the findings of this study, extensive breadth of the product

line might pose problems that are not completely solved by learning. Firms might also be unable to learn quickly enough for the new knowledge to help them cope in the market. Industry characteristics probably play a role in this, since the pace of technological development and R&D intensity can be deemed quite high in a high-technology industry like digital cameras, requiring high flexibility and adaptability from the firms competing in it. Previous studies have analyzed the US bicycle industry (Dowell 2006) and the Spanish automobile market (Barroso and Giarratana 2013), for example, in which the dynamics are very likely quite different from those of the camera industry. Prior studies have also been undertaken in quite different settings, as some have analyzed the moderating effect of breadth on the length–performance relationship (Giarratana and Fosfuri 2007), or breadth has been viewed from the standpoint of complexity (Dowell 2006).

The interaction effect is not statistically significant when the quadratic term of product line breadth is introduced into the model. The predictive power of the models is relatively the same across the linear moderation models and the quadratic model, but the coefficient of the quadratic term is highly significant and eight to ten times larger than the coefficient of the interaction term, which strongly suggests its significance. The combination of these results clearly indicate that a very broad product line is detrimental to firm performance when measured through customer evaluations and even more so under high levels of competitive intensity.

Similarly to product line length, also the point at which the relationship between product line breadth and firm performance turns negative can be determined. As the values of product line breadth vary between one and three, this means that the relationship between breadth and firm performance is in fact negative at all possible levels of product line breadth in the data. Thus, the results would actually imply a negative relationship instead of an inverted U-shaped one. Firms which focus their efforts and resources on a narrow selection of product categories seem to consistently outperform those that attempt to compete in multiple categories.

4.4.3 Competitive intensity and control variables

There are also numerous other variables that seem to affect the performance of the firm in the digital camera industry quite significantly, namely the competitive intensity of the market or the product category, the control variables measuring technical product performance (firm age, size, and tenure), and industry firm and industry product density. In terms of competitive intensity, overall, when a statistically significant effect was noted, increased competitive intensity consistently

weakened the performance of a firm. This finding is in line with previous research on the topic. The competitive dynamics view posits that increased competitive intensity hinders a firm's ability to sustain a competitive advantage and requires firms to compete more aggressively (Chen et al. 2010). Some firms might encounter difficulties with this, as it can lead to escalated costs and diminished profitability (Andrevski and Ferrier 2016). An aggressive and fast-paced environment requires firms to possess resources from which they can benefit flexibly and quickly, which might impede the development of higher-quality products.

As competitive intensity is measured through new product introductions and firm performance through customer evaluations in this study, it is also important to consider the effects of increased competitive intensity on customers. Studies have found that excessive variety hinders the customer's ability to choose, might result in uncertainty in their preferences, and makes it more likely for them to regret and be dissatisfied with their purchase decision (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992; Iyengar and Lepper 2000; Schwartz 2000). As the product introduction pace is high and there is a great deal of variety on the market, customers may view the quality of the products more critically and be less satisfied with their performance. In the study setting adopted in this dissertation, increased competitive intensity is thus likely to be reflected in the firm performance measure of customer evaluations in a negative way.

Overall, competitive intensity has been found to have an effect on resource availability (Barnett 1997), profitability (Bettis and Weeks 1987), potential market share gains (Ferrier et al. 1999), predictability (Auh and Menguc 2005), pricing (Gimeno and Woo 1999), market positioning (D'Aveni 1994), and firms' strategies in general (D'Aveni 1994; Gimeno and Woo 1996). It can thus be noted as a highly influential aspect of any industry environment, with significant effects on the operations and performance of firms in the industry.

In all of the models, the control variables used play a significant role in explaining firm performance. Not surprisingly, product performance—measured in terms of the number of megapixels and sensor size—has a positive effect on firm performance in nearly all of the product categories. These attributes have been central in driving the technological development of digital cameras and the quest to achieve better and higher-quality images. For a significant part of the period of study, marketing of the cameras was also driven by the improvements in these image quality measures.

Firm age and firm tenure, on the other hand, have a slight negative effect in almost all categories. This is supported by findings of the negative relationship

between firm age and product quality (Balasubramanian and Lee 2008) and possible conservatism and blindness to new avenues and changing customer requirements. Digital SLR cameras present an expected exception to this, as firm tenure seems to positively affect performance in the category. The SLR category is substantially different from the other two categories in the sense that customers are more quality conscious and aware of the technological developments in the industry. More experience in the industry enables the firm to obtain important and unique experience in R&D and benefit from learning effects. Loyalty is also likely to play a role, benefitting firms with longer tenure in the category.

Industry product density seems to have a slight positive effect on performance in the SLR category, but a negative one in the market as a whole. The result again highlights the differences in the environmental characteristics of different product categories. The negative relationship might be a result of multi-product firms generating weaker competition as they are forced to divide their resources among a larger number of variants, resulting in lower-quality products (Sorenson 2000). The firm performance measure of this study is especially likely to register this type of an effect, as customer evaluations portray the satisfaction of the customers on the products in the market. Similarly to long product lines, high product density in the market or category might also cause the customers to delay their purchasing decision, as they face too many options to choose from and are consequently less certain on their preferences (Dhar 1997; Greenleaf and Lehmann 1995; Shafir and Tversky 1992). In this type of a choice overload situation, the customer might also be less satisfied with their eventual selection (Scheibehenne et al. 2010).

In the SLR product category, on the other hand, higher product density seems to have a positive relationship with performance. As the overall product density in the category is significantly lower to begin with than in other product categories or the market as a whole, increased product density more likely means that customers may benefit from the positive characteristics of increased variety, such as finding products that better answer to their preferences and requirements and changes in them (Lancaster 1990; Shapiro and Varian 1998; Moreno and Terwiesch 2017).

Industry firm density, on the other hand, has a negative effect on performance in the camera market in general and in the bridge and compact categories in particular. The result is to be expected, as firm density has commonly been viewed as an antecedent to lower firm survival rates (Carroll et al. 1996; Dobrev et al. 2002). Both of the variables of firm and product density were only considered simultaneously in the analyses of the data as a whole. In smaller samples of the product categories, high autocorrelation was present between the variables, as the number of firms in

the industry is naturally linked to the overall number of products in the industry. For this reason, only one of the variables was included in the models on the product categories to depict the overall competitive structure of the industry.

5 CONCLUSIONS

5.1 Theoretical and managerial contributions

This dissertation contributes to the existing theory on product line strategy in multiple ways. First, the study contributes to the ongoing discussion on the performance effects of longer product lines. The more recent findings of an inverted U-shaped relationship between product line length and performance seem to be at least partially supported by the analyses on the digital camera industry as a whole and on the compact product category. A longer product line benefits the firm up to a certain point, after which augmenting the number of products begins to have a detrimental effect on performance. However, a vast majority of firms actually witness a negative linear relationship between increasing product line length and firm performance. This might be due to the costs associated with cannibalization, coordination, and manufacturing and operations complexities, as well as preference uncertainty among customers. Increased competitive intensity bolsters the disadvantageous effect so that firms with very long product lines perform even worse under these conditions.

Interestingly, no relationship was found in the bridge and SLR product categories, whereas the results of the market as a whole were mostly in line with the results of the compact product category. Previous research on product lines has not commonly distinguished between different product categories of a market, instead analyzing the entire market as a homogeneous set of products and firms. The findings call into question the generalizability and applicability of one product strategy to an entire market as a whole and present the view that different product categories might experience different dynamics, and whereas an active and reactive product line strategy could improve firm performance in one category, other factors might have a larger impact in other categories. When submarkets are analyzed as entities, the results might also be highly impacted by the dynamics of a dominant product category at the expense of others that experience less intense rates of new product introductions, and possess fewer products and firms. Research on product line strategies should take this into account.

Second, the results of the study contradict previous findings on the performance effects of broader product lines through the identification of a negative linear relationship with performance. The new routines, learning, and the effective and flexible division of limited resources that are required to effectively broaden the product line appear to constrain the profitability of increased breadth, and the results instead imply that firms with a more focused product line strategy outperform firms with broader strategies. Furthermore, the detrimental relationship between a broad product line and firm performance is strengthened by high levels of competitive intensity in the market.

Additionally, the lack of uniform definitions of both product line length and breadth are identified as a potential source of problems in the generalizability and comparison of previous results in the field. Extant research on product lines has often used the concepts of length and breadth interchangeably and without specific definitions. This study attempts to offer a solution by distinguishing between the concepts in an as unambiguous manner as possible and comparing the use of the concepts in previous studies on the topic. A clear distinction between length and breadth should help facilitate the comparison of future results as well as older ones.

Results of the analyses on the SLR product category imply that there are product categories with certain environmental dynamics that product line actions might not be actively used to lengthen or shorten the product line itself, but rather different aspects of the product—such as its technical performance and quality—have a more significant effect on performance. In a high-end category where firm and product densities are low, a firm's performance might in fact be more influenced by product quality and brand loyalty.

Finally, the study represents a novel initiative in the measurement of firm performance in strategy research, as online customer evaluations of the product are tested as a performance measure. These could serve as a more direct indicator of customer satisfaction (Engler et al. 2015), which in turn is strongly linked with firm performance (e.g., Williams and Naumann 2011). Additionally, online customer evaluations have been found to significantly influence the sales of a firm's products (Dellarocas et al. 2004; Park et al. 2007; Lin et al. 2011), further supporting their use as a performance measure.

In terms of product line decision-making, the findings also make some interesting contributions to managerial practice. First of all, attention should be paid to differences between product categories within the same market when planning and evaluating product strategies. Industry dynamics and customer preferences vary from one product category to another, potentially rendering a profitable strategy in

one category worthless in another. Hence, the characteristics of the particular product category and its customers should be carefully analyzed when planning product line actions.

The attainment of the optimal length and breadth of a product line present multiple contingencies that require consideration from management. In all, a careful assessment of the firm's resources and capabilities is needed to evaluate whether lengthening or broadening the product line further can be done successfully and with minimal risk of disruption to current operations. The results of this study indicate that there often are costs related to the broadening or lengthening of the product line that might overcome the benefits accrued to the firm. Intensified competition should elicit management to consider whether to scale back and focus their resources if the breadth and length of the product lines are high relative to their competitors'.

Overall, it should be recognized that there are multiple interdependencies that need to be considered in relation to product line strategy decision-making, and product categories within a submarket are often not homogeneous and should not be treated as such. The level of competitive intensity in the industry and in distinct product categories should be constantly monitored, and decisions on the culling or extending of the product line should be made based on the information gathered on the actions of the firm's competitors.

5.2 Validity and reliability

The constructs of validity and reliability are used to evaluate the implementation of the analyses and the results of the dissertation. Validity is an indicator of how well a measure actually measures the concept that it is intended to represent (Carmines and Woods 2005b), whereas reliability refers to the extent to which the results of a measurement are consistent between repeated trials (Alwin 2005). The following sections analyze the validity of the study through three different constructs: content validity, criterion-related validity, and construct validity (Carmines and Woods 2005b). Then the reliability of the measurements is reviewed.

Content validity deals with the question of whether an indicator adequately and completely represents the construct it is supposed to measure. There are two interrelated steps to obtaining content validity: specifying the entire domain of content relevant to the measurement situation in question, and selecting or constructing the indicators used in the measure. In the social sciences, the achievement of true content validity is demanding, if not impossible, as the

phenomena in question are often quite abstract and there is rarely unanimity or clear criteria for determining the comprehensiveness of the indicators (Carmines and Woods 2005b). To ensure that the content validity in this study was as high as possible, extant research on product line strategy and competition, especially from the competitive dynamics perspective, was thoroughly reviewed to identify potential indicators that should be included in the measurement of the performance effects of product line decisions. These are listed in Table 2. Many of the commonly used indicators were included in this study, and some of the popular ones were also originally tested in the models to improve their content validity. These included, for example, market growth rate, product price, and industry lifecycle stage, but as they did not improve the predictive power of the models or have significant correlation with the performance measure, they were excluded from the final models.

In the context of this dissertation, particular attention should be paid to the key measures of product line length, product line breadth, competitive intensity, and firm performance. Of these, product line length and breadth are measured through the most commonly used and unambiguous indicators, but in relation to competitive intensity, there are a number of quantifiable measures that could have been used. However, the most popular ones of firm density and product density were included as control variables in the measurement, improving the content validity of the measurement. In terms of the measurement of competitive intensity, there were also a number of other indicators constructed from the data that were tested in the models. Instead of the final selected indicator of yearly average number of new product introductions, the yearly sum, quarterly sum, and quarterly average of new product introductions were also tested. However, as new product launch decisions are often made relatively far in advance of the actual launch, and as previous research also supports a lag in competitive intensity measures, a yearly measure was deemed most appropriate.

The firm performance measure of online customer evaluations can be critiqued in this sense, as it is a simplified, single point estimate of customers' satisfaction with a product, compressing all of the reviews given of the product into a mean value of customers' opinions. Researchers commonly assume that online customer reviews reflect the customer's objective opinion and experience of the product, independent of the reviews of others (Moe and Trusov 2011), but this view has increasingly been questioned, as studies have found that online ratings are influenced by the social dynamics created by the previously posted reviews (Schlosser 2005; Li and Hitt 2008). Summarizing the ratings into a mean value also results in the loss of the underlying distribution of the reviews, which has been argued to more closely

resemble a bimodal, U-shaped distribution than a normally distributed one for reviews posted on Amazon (Hu et al. 2006). Additionally, extremely satisfied and extremely dissatisfied customers are more likely to share their views on the products (Anderson 1998), which could further bias the review data. This bias in the distribution of the reviews can, however, also be seen to improve the validity of the mean value of customer evaluations as a performance measure, since it averages out the extremes, possibly leading to a value that is more reflective of the views of the customers that were neither satisfied nor dissatisfied enough to review the product. Finally, online customer evaluations can also be manipulated by firms or their rivals themselves, the possibility of which lowers their validity as a measure. In this sense, there is no complete certainty that online customer evaluations truly represent and measure customer satisfaction, as has been posited in this study. Nevertheless, as customer evaluations still affect product sales, since customers utilize them in their purchase decision-making, the measure can be deemed as a valid indicator of firm performance.

Criterion-related validity refers to the correlation between a measure and some criterion variable of interest that is intended to be a direct measure of the concept being studied (McDonald 2005; Carmines and Woods 2005b). The firm performance measure used in this study—online customer product evaluations—is novel in product line research and began to attract attention in other related research only after the popularization of the internet and rating platforms such as Amazon in the past couple of decades. Its use in this study is, however, grounded on previous empirical research, which has shown that online customer evaluations represent customer satisfaction (Engler et al. 2015) and that customer satisfaction is strongly linked with firm performance (Williams and Naumann 2011). The criterion validity of customer evaluations as an indicator of firm performance cannot be fully ascertained, since (as was thoroughly explained in Chapter 2, section 2.2.4) there is no universally accepted, direct measure for firm performance to which the indicator used in this study can be compared.

Table 5 presents the correlations between the dependent variable and the variables used to analyze firm performance in this study. As can be noted, there is a statistically significant correlation between all of them and the dependent variable. Thus, these indicators can be deemed valid in terms of criterion-related validity (Carmines and Woods 2005b).

Construct validity refers to the constructed model being grounded in theory and the degree to which the measure fits within existing hypothesized relationships with other measures (McDonald 2005). Based on the theoretical expectations, the model should produce outcomes consistent with it. There are three steps to ensure construct validity: 1) specifying the theoretical relationships between the concepts; 2) examining the empirical relationships between the concepts; and 3) interpreting the empirical evidence in terms of how it clarifies the construct validity of the measure in question (Carmines and Woods 2005b).

The theoretical relationships between the central concepts under study have been presented and discussed in Chapter 2, section 2.2, and the hypotheses have been derived based on extant research. These actions represent the first step of ensuring construct validity. The second step goes on to test the relationships empirically. This was done through constructing quantitative models that aim to verify the hypothesized relationships. As the third step, the empirically derived results have been reflected on using existing theory and their implications discussed. Many of the hypothesized relationships are at least partially supported, and the contradictory findings were also grounded in related research, thereby improving the construct validity of the research.

Another important aspect to evaluate in quantitative research is the *reliability* of the measurements, which basically refers to the consistency of the measurement (Alwin 2005). Repeated trials of the same measurement should consistently yield similar results (Carmines and Woods 2005a). The concept is commonly divided into two distinct constructs: random and nonrandom measurement errors (Alwin 2005). Random errors in measurement refer to the factors that confound the measurement of the phenomenon by chance, thus resulting in the measurements taking slightly different values with random variances in each trial, whereas nonrandom errors are those cases for which the results are similarly erroneous in each measurement of the case (Carmines and Woods 2005a).

To some extent, random errors in measurement are always present in quantitative research. In this study, these were minimized through the triangulation of the collected data by three researchers. In addition, many data points were originally collected from multiple sources, and the values were converged so that the variables that took similar values in more than one source were deemed more reliable. Outlier values were also checked using at least one other online source to verify their correctness.

One reliability concern has to do with the hypothesized product lifetime of two years for compact and bridge cameras and four years for SLRs. There were slight discrepancies in the evaluations of the interviewed experts on how the lifetimes of each product category had evolved over the past 20 years. These mainly concerned changes in the product lifetimes, as the view was also presented that the lifetimes of bridge and SLR cameras, for example, had been shorter at the beginning of the millennium than in recent years. Some also argued that the lifetime of compact cameras was close to one year before 2010 and has increased considerably since then, by up to as much as three or four years. To ensure the reliability of the analyses, each of the models was also examined using product lifetimes that varied according to the aforementioned views. Thus, for compact digital cameras, a product lifetime of one year was assumed for the period 1999–2010, a lifetime of two years for 2011–2014, and three years after 2015. For SLRs, a product lifetime of four years was presumed until 2002, three years for 2003–2012, and five years from 2013 onwards. For bridge cameras, the lifetime was assumed to remain at two years throughout the whole period. The results using these lifetime assumptions were similar to the ones presented in this dissertation, with only very slight variations in the magnitudes of some of the coefficients. Thus, it was concluded that the lifetime assumptions made had no significant effect on the reliability of the measurements. In addition to this, robustness checks of the variables were made using yearly or monthly variables, using the data with and without outlier handling, and with two different ways of handling missing values (multiple imputation and listwise deletion).

5.3 Limitations of the research

This dissertation analyzes the product line strategies of firms in the digital camera industry during the period 1999–2017. The research setting, method, and selected variables all present limitations that should be considered in the interpretation of the results. First, the study is set in a single industry, and the product line strategies in the digital camera industry are likely to be affected by some industry-specific variables missing from the analyses. Due to this, the generalizability of the results to other industries is uncertain.

Second, the data is collected from mainstream online sources, and listwise deletion is applied to handle missing values. Both of these aspects bias the data towards large, mainstream manufacturers from the United States, Europe, or Japan. Information on smaller, privately held firms, or firms with operations in only a few non-English-speaking countries is probably lacking in the data. These smaller,

specialized firms might benefit from different types of product line strategies, and thus one should be cautious in applying the results to these types of firms. The period of study is also limited, and data on the first decade since the emergence of the digital camera industry is missing. Industry dynamics differ according to the stages of the industry lifecycle, and firms are likely to benefit from varying product line strategies under these differing conditions. For the digital camera industry, the growth period was nearing an end or ended quite near to the starting point of the analysis, and especially for the compact category, convergence with smartphones quickly changed the market. The market experienced growth in sales until 2004, after which it shrank significantly or remained comparatively similar in size to the previous year with only minimal growth until the end of 2017 (CIPA 2019). The dynamics of different lifecycle stages are not taken into account in the analyses.

Third, as stated in the previous chapter, the firm performance measure of online customer evaluations is a novel one, and it has multiple limitations. Common performance measures of market share, profit, or revenue are not utilized in the study, but the inclusion of another performance measure would have improved the validity and applicability of the results, as there is uncertainty related to the use of customer evaluations.

Fourth, since no effects of length or breadth on firm performance are found in the bridge or SLR product categories, this raises the question of whether the product categories were correctly identified. The sample sizes of these two categories are quite a bit smaller than that of compact cameras, and the bridge category in particular has been seen as quite fluid over the years, resulting in the possibility that cameras categorized as bridge could in fact more precisely represent either the compact or SLR category. Pricewise, bridge cameras have often been closer to SLRs. The study could have also potentially tested a division of the market into two product categories of high-end and low-end cameras, where bridge cameras would mostly have been classified to the same category as SLRs. Although the division of product categories is a question worth considering, the results of the entire dataset and the compact category can be considered as quite robust from this angle, as the modified classification would mostly affect the bridge and SLR categories.

There are also some limitations related to the variables utilized. As discussed, product line length, breadth, and competitive intensity have all been measured in multiple different ways in previous studies, and only one measure for each was chosen for this study. However, some of the common ways of measuring the independent variables were tested in the preliminary phase of the analyses, even though they were not included in the final models. For example, these comprise the

calculation of product line length within the product category as compared to the average product line length of competitors and compared to the rival with the longest product line. For breadth, the Berry index of dispersion was also analyzed. For the preliminary analyses, the results were similar to the ones reported here, but the explanatory power of the models was often weaker. It was thus concluded that the selected variables best depicted the dynamics in the industry.

Finally, there are also some limitations attached to the methods used in the analyses of the results. Moderated multiple regression has been critiqued for not always detecting moderator effects (Villa et al. 2003). Some of the identified problems that might have caused moderation not to be detected in the bridge and SLR categories especially include small sample size (Cohen 2013), measurement error in the variables that constitute the interaction term (Aiken et al. 1991), and intercorrelation between independent variables (Aguinis 1995).

5.4 Suggestions for future research

The results and limitations of the study suggest that there are opportunities for future research. As this was a first attempt to operationalize online customer evaluations as a measure of firm performance, future research could aim to verify the measure through incorporating additional firm performance variables into the analyses. Although the link between customer evaluations and firm performance has been studied in marketing research, this type of direct customer-side measure has not been considered in product line research. This study has begun to connect these two separate streams, but future research should more thoroughly analyze the product line factors that have a bearing on customers' views on products.

The concept of product line breadth has also attracted little attention in extant product line research. Its relationship with performance should be analyzed in other industry settings and using other performance measures. Furthermore, only two studies (Giarratana and Fosfuri 2007; Barroso and Giarratana 2013) have attempted to consider both product line length and breadth simultaneously, and both of them utilize the Berry index of dispersion as a measure of breadth and product line length measures that depart from the most commonly used ones. As both constructs clearly have an effect on firm performance in light of this and previous studies, their effects should be considered in relation to each other and utilizing different measures as well.

The results of this dissertation also highlight the idea that distinct product categories within a submarket might require distinct and varying product line

strategies to achieve higher performance. This finding merits further research in different industry settings, which could verify and analyze the types of industry conditions that lead to changes in the performance of product line strategies.

BIBLIOGRAPHY

Aaker, D.A. and Joachimsthaler, E. (2000). The Brand Relationship Spectrum: The Key to the Brand Architecture Challenge. *California Management Review*, 42(4), pp.8–23.

Agarwal, R. and Audretsch, D.B. (2001). Does Entry Size Matter? The Impact of the Life Cycle and Technology on Firm Survival. *The Journal of Industrial Economics*, 49(1), pp.21–43.

Agarwal, R. and Bayus, B.L. (2002). The Market Evolution and Sales Takeoff of Product Innovations. *Management Science*, 48(8), pp.1024–1041.

Agarwal, R., Sarkar, M.B. and Echambadi, R. (2002). The Conditioning Effect of Time on Firm Survival: An Industry Life Cycle Approach. *Academy of Management Journal*, 45(5), pp.971–994.

Aguinis, H. (1995). Statistical power problems with moderated multiple regression in management research. *Journal of Management*, 21(6), pp.1141–1158.

Aiken, L.S., West, S.G. and Reno, R.R. (1991). *Multiple regression: Testing and interpreting interactions*. SAGE Publications.

Aldrich, H. and Auster, E.R. (1986). Even dwarfs started small: Liabilities of age and size and their strategic implications. *Research in Organizational Behavior*, 8, pp.165–198.

Allison, P.D. (2002). *Quantitative Applications in the Social Sciences: Missing Data*. Thousand Oaks, CA: SAGE Publications, Inc.

Alwin, D.F. (2005). Reliability. In K. Kempf-Leonard, ed. *Encyclopedia of Social Measurement*. Amsterdam: Elsevier, pp. 351–359.

Anderson, E.W. (1998). Customer Satisfaction and Word of Mouth. *Journal of Service Research*, 1(1), pp.5–17.

Anderson, E.W., Fornell, C. and Lehmann, D.R. (1994). Customer Satisfaction, Market Share, and Profitability: Findings from Sweden. *Journal of Marketing*, 58(3), pp.53–66.

Anderson, E.W., Fornell, C. and Rust, R.T. (1997). Customer Satisfaction, Productivity, and Profitability: Differences Between Goods and Services. *Marketing Science*, 16(2), pp.129–145.

Anderson, E.W. and Sullivan, M.W. (1993). The Antecedents and Consequences of Customer Satisfaction for Firms. *Marketing Science*, 12(2), pp.125–143.

Anderson, S.W. (1995). Measuring the Impact of Product Mix Heterogeneity on Manufacturing Overhead Cost. *The Accounting Review*, 70(3), pp.363–387.

Andrevski, G. et al. (2014). Racial Diversity and Firm Performance: The Mediating Role of Competitive Intensity. *Journal of Management*, 40(3), pp.820–844.

Andrevski, G., Brass, D.J. and Ferrier, W.J. (2016). Alliance Portfolio Configurations and Competitive Action Frequency. *Journal of Management*, 42(4), pp.811–837.

Andrevski, G. and Ferrier, W.J. (2016). Does It Pay to Compete Aggressively? Contingent Roles of Internal and External Resources. *Journal of Management*, In press, pp.1–25.

Ang, S.H. (2008). Competitive intensity and collaboration: impact on firm growth across technological environments. *Strategic Management Journal*, 29(10), pp.1057–1075.

Anscombe, F.J. (1960). Rejection of Outliers. *Technometrics*, 2(2), pp.123–146.

Archak, N., Ghose, A. and Ipeirotis, P.G. (2011). Deriving the Pricing Power of Product Features by Mining Consumer Reviews. *Management Science*, 57(8), pp.1485–1509.

Auh, S. and Menguc, B. (2005). Balancing exploration and exploitation: The moderating role of competitive intensity. *Journal of Business Research*, 58(12), pp.1652–1661.

Axarloglou, K. (2008). Product Line Extensions: Causes and Effects. *Managerial and Decision Economics*, 29(1), pp.9–21.

Bailey, E.E. and Friedlaender, A.F. (1982). Market Structure and Multiproduct Industries. *Journal of Economic Literature*, 20(3), pp.1024–1048.

Balasubramanian, N. and Lee, J. (2008). Firm age and innovation. *Industrial and Corporate Change*, 17(5), pp.1019–1047.

Barnett, V. and Lewis, T. (1994). *Outliers in statistical data*. Wiley.

Barnett, W.P. (1997). The Dynamics of Competitive Intensity. *Administrative Science Quarterly*, 42(1), p.128.

Barnett, W.P. and Freeman, J. (2001). Too Much of a Good Thing? Product Proliferation and Organizational Failure. *Organization Science*, 12(5), pp.539–558.

Barnett, W.P. and Sorenson, O. (2002). The Red Queen in organizational creation and development. *Industrial and Corporate Change*, 11(2), pp.289–325.

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), pp.99–120.

Barroso, A. and Giarratana, M.S. (2013). Product Proliferation Strategies and Firm Performance: The Moderating Role of Product Space Complexity. *Strategic Management Journal*, 34(12), pp.1435–1452.

Baum, J.A.C. (1999). Organizational Ecology. In S. R. Clegg & C. Hardy, eds. *Studying Organization: Theory and Method*. Sage Publications, pp. 71–108.

Baum, J.A.C. and Korn, H.J. (1996). Competitive Dynamics of Interfirm Rivalry. *Academy of Management Journal*, 39(2), pp.255–291.

Baum, J.A.C. and Korn, H.J. (1999). Dynamics of Dyadic Competitive Interaction. *Strategic Management Journal*, 20(3), pp.251–278.

Baum, J.A.C. and Oliver, C. (1991). Institutional Linkages and Organizational Mortality. *Administrative Science Quarterly*, 36(2), p.187.

Bayus, B.L. and Putsis, W.P. (1999). Product Proliferation: An Empirical Analysis of Product Line Determinants and Market Outcomes. *Marketing Science*, 18(2), pp.137–153.

Benner, M.J. and Tripsas, M. (2012). The influence of prior industry affiliation on framing in nascent industries: the evolution of digital cameras. *Strategic Management Journal*, 33(3), pp.277–302.

Berger, J., Draganska, M. and Simonson, I. (2007). The Influence of Product Variety on Brand Perception and Choice. *Marketing Science*, 26(4), pp.460–472.

Berman, B. and Thelen, S. (2004). A guide to developing and managing a well-integrated multi- channel retail strategy. *International Journal of Retail & Distribution Management*, 32(3), pp.147–156.

Berry, W.D. and Feldman, S. (1985). Multiple Regression in Practice. In *Sage University Paper Series on Quantitative Applications in the Social Sciences*. Newbury Park, CA: Sage Publications.

Bettis, R.A. and Weeks, D. (1987). Financial returns and strategic interaction: The case of instant photography. *Strategic Management Journal*, 8(6), pp.549–563.

Blalock, H.M. (1963). Correlated Independent Variables: The Problem of Multicollinearity. *Social Forces*, 42(2), pp.233–237.

Boone, J. (2008). A New Way to Measure Competition. *The Economic Journal*, 118(531), pp.1245–1261.

Boone, J. (2000). Competitive Pressure: The Effects on Investments in Product and Process Innovation. *The RAND Journal of Economics*, 31(3), p.549.

Bordley, R. (2003). Determining the Appropriate Depth and Breadth of a Firm's Product Portfolio. *Journal of Marketing Research*, 40(1), pp.39–53.

Boulding, W. and Christen, M. (2009). Pioneering Plus a Broad Product Line Strategy: Higher Profits or Deeper Losses? *Management Science*, 55(6), pp.958–967.

Boulding, W. and Staelin, R. (1995). Identifying Generalizable Effects of Strategic Actions on Firm Performance: The Case of Demand-Side Returns to R&D Spending. *Marketing Science*, 14(3), pp.222–236.

Bowen, H.P. and Wiersema, M.F. (2005). Foreign-based competition and corporate diversification strategy. *Strategic Management Journal*, 26(12), pp.1153–1171.

Boyd, H.W. and Headen, R.S. (1978). Definition and management of product-market portfolio. *Industrial Marketing Management*, 7(5), pp.337–346.

Boyd, J.L. and Bresser, R.K.F. (2008). Performance implications of delayed competitive responses: evidence from the U.S. retail industry. *Strategic Management Journal*, 29(10), pp.1077–1096.

Brander, J.A. and Eaton, J. (1984). Product Line Rivalry. *The American Economic Review*, 74(3), pp.323–334.

Le Breton-Miller, I., Miller, D. and Lester, R.H. (2011). Stewardship or Agency? A Social Embeddedness Reconciliation of Conduct and Performance in Public Family Businesses. *Organization Science*, 22(3), pp.704–721.

Brynjolfsson, E., Hu, Y. (Jeffrey) and Smith, M.D. (2003). Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers. *Management Science*, 49(11), pp.1580–1596.

Cadogan, J.W. et al. (2001). Key antecedents to "export" market-oriented behaviors: a cross-national empirical examination. *International Journal of Research in Marketing*, 18(3), pp.261–282.

Cadogan, J.W., Cui, C.C. and Kwok Yeung Li, E. (2003). Export market- oriented behavior and export performance. *International Marketing Review*, 20(5), pp.493–513.

Cardozo, R. et al. (1993). Product-Market Choices and Growth of New Businesses. *Journal of Product Innovation Management*, 10(4), pp.331–340.

Carmines, E.G. and Woods, J.A. (2005a). Reliability Assessment. In K. Kempf-Leonard, ed. *Encyclopedia of Social Measurement*. Amsterdam: Elsevier, pp. 361–365.

Carmines, E.G. and Woods, J.A. (2005b). Validity assessment. In K. Kempf-Leonard, ed. *Encyclopedia of Social Measurement*. Amsterdam: Elsevier, pp. 933–937.

Carroll, G.R. (1985). Concentration and Specialization: Dynamics of Niche Width in Populations of Organizations. *American Journal of Sociology*, 90(6), pp.1262–1283.

Carroll, G.R. et al. (1996). The Fates of De Novo and De Alio Producers in the American Automobile Industry 1885-1981. *Strategic Management Journal*, 17, pp.117–137.

Carroll, G.R. and Hannan, M.T. (1989). Density Delay in the Evolution of Organizational Populations: A Model and Five Empirical Tests. *Administrative Science Quarterly*, 34(3), pp.411–430.

Carroll, G.R. and Swaminathan, A. (2000). Why the Microbrewery Movement? Organizational Dynamics of Resource Partitioning in the U.S. Brewing Industry. *American Journal of Sociology*, 106(3), pp.715–762.

Carton, R. and Hofer, C. (2010). Organizational Financial Performance: Identifying and Testing Multiple Dimensions. *Academy of Entrepreneurship Journal*, 16(2), pp.1–22.

Carton, R.B. (2004). *Measuring organizational performance: An exploratory study*. University of Georgia.

Caves, R.E., Fortunato, M. and Ghemawat, P. (1984). The Decline of Dominant Firms, 1905-1929. *The Quarterly Journal of Economics*, 99(3), p.523.

Caves, R.E. and Porter, M.E. (1977). From Entry Barriers to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition. *The Quarterly Journal of Economics*, 91(2), p.241.

Chakravarthy, B.S. (1986). Measuring strategic performance. *Strategic Management Journal*, 7(5), pp.437–458.

Chan, R.Y.K. et al. (2012). Environmental orientation and corporate performance: The mediation mechanism of green supply chain management and moderating

effect of competitive intensity. *Industrial Marketing Management*, 41(4), pp.621–630.
Chatterjee, S. and Hadi, A.S. (2006). *Regression Analysis by Example*. New York: Wiley.
Chen, K.D. and Hausman, W.H. (2000). Technical Note: Mathematical Properties of the Optimal Product Line Selection Problem Using Choice-Based Conjoint Analysis. *Management Science*, 46(2), pp.327–332.
Chen, M.-J. (1996). Competitor Analysis and Interfirm Rivalry: Toward a Theoretical Integration. *The Academy of Management Review*, 21(1), p.100.
Chen, M.-J. et al. (2002). The role of irreversibilities in competitive interaction: behavioral considerations from organization theory. *Managerial and Decision Economics*, 23(4–5), pp.187–207.
Chen, M.-J. and Hambrick, D.C. (1995). Speed, Stealth, and Selective Attack: How Small Firms Differ from Large Firms in Competitive Behavior. *Academy of Management Journal*, 38(2), pp.453–482.
Chen, M.-J., Lin, H.-C. and Michel, J.G. (2010). Navigating in a hypercompetitive environment: the roles of action aggressiveness and TMT integration. *Strategic Management Journal*, 31(13), pp.1410–1430.
Chen, M.-J. and MacMillan, I.C. (1992). Nonresponse and Delayed Response to Competitive Moves: The Roles of Competitor Dependence and Action Irreversibility. *Academy of Management Journal*, 35(3), pp.539–570.
Chen, M.-J. and Miller, D. (1994). Competitive Attack, Retaliation and Performance: An Expectancy-Valence Framework. *Strategic Management Journal*, 15(2), pp.85–102.
Chen, M.-J. and Miller, D. (2012). Competitive Dynamics: Themes, Trends, and a Prospective Research Platform. *The Academy of Management Annals*, 6(1), pp.135–210.
Chen, M.-J. and Miller, D. (2015). Reconceptualizing competitive dynamics: A multidimensional framework. *Strategic Management Journal*, 36(5), pp.758–775.
Chen, M.-J., Smith, K.G. and Grimm, C.M. (1992). Action Characteristics as Predictors of Competitive Responses. *Management Science*, 38(3), pp.439–455.
Chen, M.-J., Su, K.-H. and Tsai, W. (2007). Competitive Tension: The Awareness-Motivation-Capability Perspective. *The Academy of Management Journal*, 50(1), pp.101–118.
Chenhall, R.H. and Langfield-Smith, K. (2007). Multiple Perspectives of Performance Measures. *European Management Journal*, 25(4), pp.266–282.
Chernev, A. (2003). When More Is Less and Less Is More: The Role of Ideal Point Availability and Assortment in Consumer Choice. *Journal of Consumer Research*, 30(2), pp.170–183.
Chernev, A., Böckenholt, U. and Goodman, J. (2015). Choice overload: A conceptual review and meta-analysis. *Journal of Consumer Psychology*, 25(2), pp.333–358.
Chisholm, D.C. and Norman, G. (2012). Market access and competition in product lines. *International Journal of Industrial Organization*, 30(5), pp.429–435.

Chong, J.-K., Ho, T.-H. and Tang, C.S. (1998). Product Structure, Brand Width and Brand Share. In *Product Variety Management*. Boston, MA: Springer, pp. 39–64.
Christensen, C.M. (1997). Patterns in the evolution of product competition. *European Management Journal*, 15(2), pp.117–127.
Churchill, G.A., Surprenant, C. and Surprenant, C. (1982). An Investigation into the Determinants of Customer Satisfaction. *Journal of Marketing Research*, 19(4), p.491.
CIPA. (2019). *Digital camera statistics*. [online]. Available from: http://www.cipa.jp/stats/dc-2015_e.html.
Clemons, E.K. (2008). How Information Changes Consumer Behavior and How Consumer Behavior Determines Corporate Strategy. *Journal of Management Information Systems*, 25(2), pp.13–40.
Clemons, E.K. and Gao, G. (Gordon). (2008). Consumer informedness and diverse consumer purchasing behaviors: Traditional mass-market, trading down, and trading out into the long tail. *Electronic Commerce Research and Applications*, 7(1), pp.3–17.
Clemons, E.K., Gao, G.G. and Hitt, L.M. (2006). When online reviews meet hyperdifferentiation: A study of the craft beer industry. *Journal of Management Information Systems*, 23(2), pp.149–171.
Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.
Cook, R.D. (1977). Detection of Influential Observation in Linear Regression. *Technometrics*, 19(1), pp.15–18.
Cool, K. and Dierickx, I. (1993). Rivalry, strategic groups and firm profitability. *Strategic Management Journal*, 14(1), pp.47–59.
Cool, K.O. and Schendel, D. (1987). Strategic Group Formation and Performance: The Case of the U.S. Pharmaceutical Industry, 1963-1982. *Management Science*, 33(9), pp.1102–1124.
Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. (1999). New Product Protfolio Management: Practices and Performance. *Journal of Product Innovation Management*, 16(4), pp.333–351.
Corey, E.R. (1975). Key options in market selection and product planning. *Harvard Business Review*, (Sept-Oct), pp.119–128.
Cottrell, T. and Nault, B.R. (2004). Product variety and firm survival in the microcomputer software industry. *Strategic Management Journal*, 25(10), pp.1005–1025.
D'Aveni, R. (1994). *Hypercompetition: Managing the Dynamics of Strategic Maneuvering*. New York: Free Press.
D'Aveni, R.A., Dagnino, G.B. and Smith, K.G. (2010). The age of temporary advantage. *Strategic Management Journal*, 31(13), pp.1371–1385.
Dalton, D.R. et al. (1980). Organization Structure and Performance: A Critical Review. *Academy of Management Review*, 5(1), pp.49–64.

Davis, R. and Thomas, L.G. (1993). Direct Estimation of Synergy: A New Approach to the Diversity-Performance Debate. *Management Science*, 39(11), pp.1334–1346.

Dawson, J.F. (2014). Moderation in Management Research: What, Why, When, and How. *Journal of Business and Psychology*, 29(1), pp.1–19.

Day, G.S. (1977). Diagnosing the Product Portfolio. *Journal of Marketing*, 41(2).

Degryse, H. (1996). On the Interaction Between Vertical and Horizontal Product Differentiation: An Application to Banking. *The Journal of Industrial Economics*, 44(2), p.169.

Delacroix, J. and Swaminathan, A. (1991). Cosmetic, Speculative, and Adaptive Organizational Change in the Wine Industry: A Longitudinal Study. *Administrative Science Quarterly*, 36(4), p.631.

Dellarocas, C., Awad, N.F. and Zhang, X. (2004). Exploring the Value of Online Reviews to Organizations: Implications for Revenue Forecasting and Planning. In *Proceedings of the International Conference on Information Systems (ICIS 2004)*. Washington, D.C.

Dellarocas, C., Zhang, X. (Michael) and Awad, N.F. (2007). Exploring the value of online product reviews in forecasting sales: The case of motion pictures. *Journal of Interactive Marketing*, 21(4), pp.23–45.

Derfus, P.J. et al. (2008). The Red Queen Effect: Competitive Actions And Firm Performance. *Academy of Management Journal*, 51(1), pp.61–80.

Dess, G.G. and Beard, D.W. (1984). Dimensions of Organizational Task Environments. *Administrative Science Quarterly*, 29(1), p.52.

Devinney, T.M. and Stewart, D.W. (1988). Rethinking the Product Portfolio: A Generalized Investment Model. *Management Science*, 34(9), pp.1080–1095.

Dhar, R. (1997). Consumer Preference for a No- Choice Option. *Journal of Consumer Research*, 24(2), pp.215–231.

Diehl, K. and Poynor, C. (2010). Great Expectations?! Assortment Size, Expectations, and Satisfaction. *Journal of Marketing Research*, 47(2), pp.312–322.

Dobrev, S.D., Kim, T.-Y. and Carroll, G.R. (2003). Shifting Gears, Shifting Niches: Organizational Inertia and Change in the Evolution of the U.S. Automobile Industry, 1885–1981. *Organization Science*, 14(3), pp.264–282.

Dobrev, S.D., Kim, T.-Y. and Carroll, G.R. (2002). The Evolution of Organizational Niches: U.S. Automobile Manufacturers, 1885-1981. *Administrative Science Quarterly*, 47(2), p.233.

Dobrev, S.D., Kim, T. and Hannan, M.T. (2001). Dynamics of Niche Width and Resource Partitioning. *American Journal of Sociology*, 106(5), pp.1299–1337.

Dowell, G. (2006). Product Line Strategies of New Entrants in an Established Industry: Evidence from the US Bicycle Industry. *Strategic Management Journal*, 27(10), pp.959–979.

Draganska, M. and Jain, D.C. (2005). Product-Line Length as a Competitive Tool. *Journal of Economics and Management Strategy*, 14(1), pp.1–28.

Dunne, P. and Hughes, A. (1994). Age, Size, Growth and Survival: UK Companies in the 1980s. *The Journal of Industrial Economics*, 42(2), p.115.

Durand, R. and Coeurderoy, R. (2001). Age, order of entry, strategic orientation, and organizational performance. *Journal of Business Venturing*, 16(5), pp.471–494.

Durbin, J. and Watson, G.S. (1951). Testing for Serial Correlation in Least Squares Regression, II. *Biometrika*, 38, pp.159–77.

Edwards, C.D. (1955). Conglomerate bigness as a source of power. In *Business concentration and price policy*. Princeton, NJ: Princeton University Press, pp. 331–352.

Eggers, J.P. (2012). All experience is not created equal: learning, adapting, and focusing in product portfolio management. *Strategic Management Journal*, 33(3), pp.315–335.

Engler, T.H., Winter, P. and Schulz, M. (2015). Understanding online product ratings: A customer satisfaction model. *Journal of Retailing and Consumer Services*, 27, pp.113–120.

Evans, D.H. (1963). Modular Design-A Special Case in Nonlinear Programming. *Operations research*, 11(4), pp.637–647.

Farjoun, M. (1994). Beyond Industry Boundaries: Human Expertise, Diversification and Resource-Related Industry Groups. *Organization Science*, 5(2), pp.185–199.

Farjoun, M. and Lai, L. (1997). Similarity judgments in strategy formulation: Role, process and implications. *Strategic Management Journal*, 18(4), pp.255–273.

Fasolo, B., Carmeci, F.A. and Misuraca, R. (2009). The effect of choice complexity on perception of time spent choosing: When choice takes longer but feels shorter. *Psychology and Marketing*, 26(3), pp.213–228.

Ferrier, W.J. (2001). Navigating the Competitive Landscape: The Drivers and Consequences of Competitive Aggressiveness. *Academy of Management Journal*, 44(4), pp.858–877.

Ferrier, W.J. et al. (2002). The impact of performance distress on aggressive competitive behavior: a reconciliation of conflicting views. *Managerial and Decision Economics*, 23(4–5), pp.301–316.

Ferrier, W.J. (1997). 'Tough talk' and market leaders: The role of overt signaling and reputation-building behaviors in sustaining industry dominance. *Corporate Reputation Review*, 1(2), pp.98–103.

Ferrier, W.J. and Lee, H. (2002). Strategic Aggressiveness, Variation, And Surprise: How The Sequential Pattern Of Competitive Rivalry Influences Stock Market Returns. *Journal of Managerial Issues*, 14(2), pp.162–180.

Ferrier, W.J. and Lyon, D.W. (2004). Competitive repertoire simplicity and firm performance: The moderating role of top management team heterogeneity. *Managerial and Decision Economics*, 25(67), pp.317–327.

Ferrier, W.J., Smith, K.G. and Grimm, C.M. (1999). The Role of Competitive Action in Market Share Erosion and Industry Dethronement: A Study of Industry Leaders and Challengers. *Academy of Management Journal*, 42(4), pp.372–388.

Field, A.P. (2009). *Discovering statistics using SPSS*. Sage Publications.

Fombrun, C.J. and Ginsberg, A. (1990). Shifting gears: Enabling change in corporate aggressiveness. *Strategic Management Journal*, 11(4), pp.297–308.
Fombrun, C.J. and Shanley, M. (1990). What's in a Name? Reputation Building and Corporate Strategy. *Academy of Management Journal*, 33(2), pp.233–258.
Ford, J.D. and Schellenberg, D.A. (1982). Conceptual Issues of Linkage in the Assessment of Organizational Performance. *Academy of Management Review*, 7(1), pp.49–58.
Fornell, C. et al. (1996). The American Customer Satisfaction Index: Nature, Purpose, and Findings. *Journal of Marketing*, 60(4), pp.7–18.
Freeman, J., Carroll, G.R. and Hannan, M.T. (1983). The Liability of Newness: Age Dependence in Organizational Death Rates. *American Sociological Review*, 48(5), p.692.
Frey, B.B. (2018). *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*. B. B. Frey, ed. Thousand Oaks, CA: SAGE Publications, Inc.
Gal-Or, E. (1985). First Mover and Second Mover Advantages. *International Economic Review*, 26(3), p.649.
Gang, K., Jeong, M. and Park, M. (2018). Industry shakeouts and product strategies: lessons from the US laser printer industry. *Technology Analysis & Strategic Management*, 30(10), pp.1182–1194.
Garud, R. and Kumaraswamy, A. (1993). Changing Competitive Dynamics in Network Industries: An Exploration of Sun Microsystems' Open Systems Strategy. *Strategic Management Journal*, 14(5), pp.351–369.
Gary, M.S. (2005). Implementation strategy and performance outcomes in related diversification. *Strategic Management Journal*, 26(7), pp.643–664.
Giachetti, C. and Dagnino, G.B. (2014). Detecting the Relationship Between Competitive Intensity and Firm Product Line Length : Evidence From the Worldwide Mobile Phone Industry. *Strategic Management Journal*, 35(9), pp.1398–1409.
Giachetti, C. and Lampel, J. (2010). Keeping both eyes on the competition: Strategic adjustment to multiple targets in the UK mobile phone industry. *Strategic Organization*, 8(4), pp.347–376.
Giarratana, M.S. and Fosfuri, A. (2007). Product Strategies and Survival in Schumpeterian Environments: Evidence from the US Security Software Industry. *Organization Studies*, 28(6), pp.909–929.
Gimeno, J. (1999). Reciprocal threats in multimarket rivalry: staking out 'spheres of influence' in the U.S. airline industry. *Strategic Management Journal*, 20(2), pp.101–128.
Gimeno, J. and Woo, C.Y. (1996). Hypercompetition in a Multimarket Environment: The Role of Strategic Similarity and Multimarket Contact in Competitive De-Escalation. *Organization Science*, 7(3), pp.322–341.
Gimeno, J. and Woo, C.Y. (1999). Multimarket Contact, Economies of Scope, and Firm Performance. *Academy of Management Journal*, 42(3), pp.239–259.

Godes, D. and Mayzlin, D. (2004). Using Online Conversations to Study Word-of-Mouth Communication. *Marketing Science*, 23(4), pp.545–560.
Graddy, K. (1995). Testing for Imperfect Competition at the Fulton Fish Market. *The RAND Journal of Economics*, 26(1), pp.75–92.
Greenleaf, E.A. and Lehmann, D.R. (1995). Reasons for Substantial Delay in Consumer Decision Making. *Journal of Consumer Research*, 22(2), p.186.
Grimm, C.M., Lee, H. and Smith, K.G. (2005). *Strategy as Action: Competitive Dynamics and Competitive Advantage*. Oxford, England: Oxford University Press.
Grimm, C.M. and Smith, K.G. (1997). *Strategy as action: Industry rivalry and coordination*. South-Western College Pub.
Gupta, A.K. and Govindarajan, V. (1986). Resource Sharing Among SBUs: Strategic Antecedents and Administrative Implications. *Academy of Management Journal*, 29(4), pp.695–714.
Hambrick, D.C., Cho, T.S. and Chen, M.-J. (1996). The Influence of Top Management Team Heterogeneity on Firms' Competitive Moves. *Administrative Science Quarterly*, 41(4), p.659.
Hannan, M.T. and Carroll, G.R. (1992). *Dynamics of organizational populations: Density, legitimation, and competition*. New York: Oxford University Press.
Hannan, M.T. and Freeman, J. (1989). *Organizational Ecology*. Cambridge, MA: Harvard University Press.
Hannan, M.T. and Freeman, J. (1977). The Population Ecology of Organizations. *American Journal of Sociology*, 82(5), pp.929–964.
Hayes, R.H. and Wheelwright, S.C. (1984). *Restoring our Competitive Edge: Competing Through Manufacturing*. New York, NY: John Wiley & Sons.
Hayes, R.H., Wheelwright, S.C. and Clark, K.B. (1988). *Dynamic Manufacturing*. New York: The Free Press.
Helfat, C.E. and Eisenhardt, K.M. (2004). Inter-Temporal Economies of Scope, Organizational Modularity, and the Dynamics of Diversification. *Strategic Management Journal*, 25(13), pp.1217–1232.
Henderson, A.D. (1999). Firm Strategy and Age Dependence: A Contingent View of the Liabilities of Newness, Adolescence, and Obsolescence. *Administrative Science Quarterly*, 44(2), p.281.
Henderson, R.M. and Clark, K.B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, 35(1), pp.9–30.
Herrmann, A., Huber, F. and Braunstein, C. (2000). Market-driven product and service design: Bridging the gap between customer needs, quality management, and customer satisfaction. *International Journal of Production Economics*, 66(1), pp.77–96.
Hofer, C.W. and Sandberg, W.R. (1987). Improving New Venture Performance: Some Guidelines for Success. *American Journal of Small Business*, 12(1), pp.11–26.

Hsu, G., Hannan, M.T. and Koçak, Ö. (2009). Multiple Category Memberships in Markets: An Integrative Theory and Two Empirical Tests. *American Sociological Review*, 74(1), pp.150–169.

Hu, N., Koh, N.S. and Reddy, S.K. (2014). Ratings lead you to the product, reviews help you clinch it? The mediating role of online review sentiments on product sales. *Decision Support Systems*, 57, pp.42–53.

Hu, N., Pavlou, P.A. and Zhang, J. (2006). Can online reviews reveal a product's true quality? In *Proceedings of the 7th ACM conference on Electronic commerce - EC '06*. New York, New York, USA: ACM Press, pp. 324–330.

Hughes-Morgan, M., Kolev, K. and Mcnamara, G. (2018). A meta-analytic review of competitive aggressiveness research. *Journal of Business Research*, 85, pp.73–82.

Hui, K.-L. (2004). Product Variety under Brand Influence: An Empirical Investigation of Personal Computer Demand. *Management Science*, 50(5), pp.686–700.

Iyengar, S.S. and Lepper, M.R. (2000). When choice is demotivating: can one desire too much of a good thing? *Journal of personality and social psychology*, 79(6), pp.995–1006.

Jacobson, R. (1992). The "Austrian" School of Strategy. *Academy of Management Review*, 17(4), pp.782–807.

Jacobson, R. and Aaker, D.A. (1985). Is Market Share All That It's Cracked up to Be? *Journal of Marketing*, 49(4), p.11.

Jaworski, B.J. and Kohli, A.K. (1993). Market Orientation: Antecedents and Consequences. *Journal of Marketing*, 57(3), p.53.

Jeong, M., Kim, B.-I. and Gang, K. (2017). Competition, product line length, and firm survival: evidence from the US printer industry. *Technology Analysis & Strategic Management*, 29(7), pp.762–774.

Jones, G.R. and Hill, C.W.L. (1988). Transaction cost analysis of strategy-structure choice. *Strategic Management Journal*, 9(2), pp.159–172.

Jones, N. (2003). Competing after radical technological change: the significance of product line management strategy. *Strategic Management Journal*, 24(13), pp.1265–1287.

Kadiyali, V., Vilcassim, N. and Chintagunta, P. (1998). Product line extensions and competitive market interactions: An empirical analysis. *Journal of Econometrics*, 89(1), pp.339–363.

Kahn, B.E. (1995). Consumer variety-seeking among goods and services. *Journal of Retailing and Consumer Services*, 2(3), pp.139–148.

Kang, H. and Song, J. (2017). Innovation and recurring shifts in industrial leadership: Three phases of change and persistence in the camera industry. *Research Policy*, 46(2), pp.376–387.

Kaplan, R.S. (1983). Measuring manufacturing performance: a new challenge for managerial accounting research. In *Readings in Accounting for Management Control*. Boston, MA: Springer US, pp. 284–306.

Kekre, S. and Srinivasan, K. (1990). Broader Product Line: A Necessity to Achieve Success? *Management Science*, 36(10), pp.1216–1231.
Ketchen, D.J., Snow, C.C. and Hoover, V.L. (2004). Research on Competitive Dynamics: Recent Accomplishments and Future Challenges. *Journal of Management*, 30(6), pp.779–804.
Kilduff, G.J., Elfenbein, H.A. and Staw, B.M. (2010). The Psychology of Rivalry: A Relationally Dependent Analysis of Competition. *Academy of Management Journal*, 53(5), pp.943–969.
Kim, D.-J. and Kogut, B. (1996). Technological Platforms and Diversification. *Organization Science*, 7(3), pp.283–301.
King, R.C., Sen, R. and Xia, M. (2004). Impact of Web-based e-Commerce on Channel Strategy in Retailing. *International Journal of Electronic Commerce*, 8(3), pp.103–130.
Klemperer, P. (1995). Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics, and International Trade. *The Review of Economic Studies*, 62(4), pp.515–539.
Klepper, S. (1997). Industry Life Cycles. *Industrial and Corporate Change*, 6(1), pp.145–181.
Klepper, S. and Thompson, P. (2006). Submarkets and the Evolution of Market Structure. *The RAND Journal of Economics*, 37(4), pp.861–886.
Kogut, B. and Zander, U. (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, 3(3), pp.383–397.
Koh, N.S. and Hu, N. (2010). Do online reviews reflect a product's true perceived quality? An investigation of online movie reviews across cultures. *Electronic Commerce Research and Applications*, 9(5), pp.374–385.
Kotler, P. and Keller, K.L. (2015). *Marketing Management*. 15th ed. Pearson Education Ltd.
Kristenson, L. (1983). Strategic Planning in Retail. *European Journal of Marketing1*, 17(2), pp.43–59.
Lal, R. and Matutes, C. (1994). Retail Pricing and Advertising Strategies. *The Journal of Business*, 67(3), p.345.
Lamberg, J.-A. et al. (2009). Competitive dynamics, strategic consistency, and organizational survival. *Strategic Management Journal*, 30(1), pp.45–60.
Lancaster, K. (1990). The Economics of Product Variety: A Survey. *Marketing Science*, 9(3), pp.189–206.
Lawler, E.E. and Porter, L.W. (1967). Antecedent attitudes of effective managerial performance. *Organizational Behavior and Human Performance*, 2(2), pp.122–142.
Levins, R. (1968). *Evolution in changing environments: some theoretical explorations*. Princeton University Press.
Levitt, B. and March, J.G. (1988). Organizational Learning. *Annual Review of Sociology*, 14(1), pp.319–338.

Li, S.X. and Greenwood, R. (2004). The effect of within-industry diversification on firm performance: synergy creation, multi-market contact and market structuration. *Strategic Management Journal*, 25(12), pp.1131–1153.
Li, X. and Hitt, L.M. (2008). Self-Selection and Information Role of Online Product Reviews. *Information Systems Research*, 19(4), pp.456–474.
Lieberman, M.B. and Montgomery, D.B. (2013). Conundra and Progress: Research on Entry Order and Performance. *Long Range Planning*, 46(4–5), pp.312–324.
Lin, C.-L., Lee, S.-H. and Horng, D.-J. (2011). The effects of online reviews on purchasing intention: The moderating role of need for cognition. *Social Behavior and Personality: an international journal*, 39(1), pp.71–81.
Little, R.J.A. (1988). A Test of Missing Completely at Random for Multivariate Data with Missing Values. *Journal of the American Statistical Association*, 83(404), pp.1198–1202.
Liu, Y. (2006). Word of Mouth for Movies: Its Dynamics and Impact on Box Office Revenue. *Journal of Marketing*, 70(3), pp.74–89.
Maccrimmon, K.R. (1993). Do firm strategies exist? *Strategic Management Journal*, 14(S2), pp.113–130.
MacMillan, I., McCaffery, M.L. and Van Wijk, G. (1985). Competitors' responses to easily imitated new products—exploring commercial banking product introductions. *Strategic Management Journal*, 6(1), pp.75–86.
Marino, K.E. and De Noble, A.F. (1997). Growth and early returns in technology-based manufacturing ventures. *The Journal of High Technology Management Research*, 8(2), pp.225–242.
Markides, C.C. and Williamson, P.J. (1994). Related diversification, core competences and corporate performance. *Strategic Management Journal*, 15(S2), pp.149–165.
Matsubayashi, N. et al. (2009). Full-line or specialization strategy? The negative effect of product variety on product line strategy. *European Journal of Operational Research*, 196(2), pp.795–807.
McDonald, M.P. (2005). Validity, Data Sources. In K. Kempf-Leonard, ed. *Encyclopedia of Social Measurement*. Amsterdam: Elsevier, pp. 939–948.
McNally, R.C., Durmuşoğlu, S.S. and Calantone, R.J. (2013). New Product Portfolio Management Decisions: Antecedents and Consequences. *Journal of Product Innovation Management*, 30(2), pp.245–261.
Mezias, S.J. and Boyle, E. (2005). Blind Trust: Market Control, Legal Environments, and the Dynamics of Competitive Intensity in the Early American Film Industry, 1893–1920. *Administrative Science Quarterly*, 50(1), pp.1–34.
Miller, D. (1993). The Architecture of Simplicity. *Academy of Management Review*, 18(1), pp.116–138.
Miller, D. (1990). *The Icarus paradox: How exceptional companies bring about their own downfall*. New York: Harper Collins.
Miller, D. and Chen, M.-J. (1996a). Nonconformity in Competitive Repertoires: A Sociological View of Markets. *Social Forces*, 74(4), pp.1209–1234.

Miller, D. and Chen, M.-J. (1994). Sources and Consequences of Competitive Inertia: A Study of the U.S. Airline Industry. *Administrative Science Quarterly*, 39(1), p.1.
Miller, D. and Chen, M.-J. (1996b). The Simplicity of Competitive Repertoires: An Empirical Analysis. *Strategic Management Journal*, 17(6), pp.419–439.
Miller, D.J. (2006). Technological diversity, related diversification, and firm performance. *Strategic Management Journal*, 27(7), pp.601–619.
Mintzberg, H. and Waters, J.A. (1985). Of strategies, deliberate and emergent. *Strategic Management Journal*, 6(3), pp.257–272.
Mises, L. Von. (1949). *Human action; a treatise on economics*. New Haven: Yale University Press.
Mitchell, W. (1991). Dual Clocks: Entry Order Influences on Incumbent and Newcomer Market Share and Survival When Specialized Assets Retain Their Value. *Strategic Management Journal*, 12(2), pp.85–100.
Mitchell, W. (1989). Whether and When? Probability and Timing of Incumbents' Entry into Emerging Industrial Subfields. *Administrative Science Quarterly*, 34(2), pp.208–230.
Moe, W.W. and Trusov, M. (2011). The Value of Social Dynamics in Online Product Ratings Forums. *Journal of Marketing Research*, 48(3), pp.444–456.
Moorthy, K.S. and Png, I.P.L. (1992). Market Segmentation, Cannibalization, and the Timing of Product Introductions. *Management Science*, 38(3), pp.345–359.
Moreno, A. and Terwiesch, C. (2017). The Effects of Product Line Breadth: Evidence from the Automotive Industry. *Marketing Science*, 36(2), pp.254–271.
Murphy, G.B., Trailer, J.W. and Hill, R.C. (1996). Measuring performance in entrepreneurship research. *Journal of Business Research*, 36(1), pp.15–23.
Ndofor, H.A., Sirmon, D.G. and He, X. (2011). Firm resources, competitive actions and performance: investigating a mediated model with evidence from the in-vitro diagnostics industry. *Strategic Management Journal*, 32(6), pp.640–657.
Nelson, R.R. and Winter, S.G. (1982). *An evolutionary theory of economic change*. Belknap Press of Harvard University Press.
Novick, L.R. (1988). Analogical transfer, problem similarity, and expertise. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 14(3), p.510.
Oliver, C. (1997). Sustainable competitive advantage: combining institutional and resource-based views. *Strategic Management Journal*, 18(9), pp.697–713.
Orr, J.M., Sackett, P.R. and Dubois, C.L.Z. (1991). Outlier detection and treatment in I/O psychology: A survey of researcher beliefs and an empirical illustration. *Personnel Psychology*, 44(3), pp.473–486.
Osborne, J.W. and Overbay, A. (2008). Best Practices in Data Cleaning: How Outliers and "Fringeliers" Can Increase Error Rates and Decrease the Quality and Precision of Your Results. In J. Osborne, ed. *Best Practices in Quantitative Methods*. Thousand Oaks, CA: SAGE Publications, Inc., pp. 205–213.
Osborne, J.W. and Waters, E. (2002). Four Assumptions of Multiple Regression That Researchers Should Always Test. - Practical Assessment, Research & Evaluation. *Practical Assessment, Research & Evaluation*, 8(2).

Palich, L.E., Cardinal, L.B. and Miller, C.C. (2000). Curvilinearity in the diversification-performance linkage: an examination of over three decades of research. *Strategic Management Journal*, 21(2), pp.155–174.

Park, D.-H., Lee, J. and Han, I. (2007). The Effect of On-Line Consumer Reviews on Consumer Purchasing Intention: The Moderating Role of Involvement. *International Journal of Electronic Commerce*, 11(4), pp.125–148.

Peltoniemi, M. (2011). Reviewing Industry Life-cycle Theory: Avenues for Future Research. *International Journal of Management Reviews*, 13(4), pp.349–375.

Peteraf, M.A. (1993). Intra-industry structure and the response toward rivals. *Managerial and Decision Economics*, 14(6), pp.519–528.

Phillips, L.W., Chang, D.R. and Buzzell, R.D. (1983). Product Quality, Cost Position and Business Performance: A Test of Some Key Hypotheses. *Journal of Marketing*, 47(2), p.26.

Podolny, J.M., Stuart, T.E. and Hannan, M.T. (1996). Networks, Knowledge, and Niches: Competition in the Worldwide Semiconductor Industry, 1984-1991. *American Journal of Sociology*, 102(3), pp.659–689.

Porter, M.E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press.

Porter, M.E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.

Porter, M.E. (1979a). How competitive forces shape strategy. *Harvard Business Review*, (March-April), pp.137–145.

Porter, M.E. (1976). *Interbrand Choice, Strategy, and Bilateral Market Power*. Cambridge, MA: Harvard University Press.

Porter, M.E. (1979b). The Structure within Industries and Companies' Performance. *The Review of Economics and Statistics*, 61(2), p.214.

Porter, M.E. (1991). Towards a Dynamic Theory of Strategy. *Strategic Management Journal*, 12(Special Issue: Fundamental Research Issues in Strategy and Economics), pp.95–117.

Putsis, W.P. (1997). An Empirical Study of the Effect of Brand Proliferation on Private Label – National Brand Pricing Behavior. *Review of Industrial Organization*, 12(3), pp.355–371.

Putsis, W.P. and Bayus, B.L. (2001). An empirical analysis of firms' product line decisions. *Journal of Marketing Research*, 38(1), pp.110–118.

Quelch, J.A. and Kenny, D. (1994). Extend Profits, not Product Lines. *Harvard Business Review*, 72(5), pp.153–160.

Ramaswamy, K. (2001). Organizational ownership, competitive intensity, and firm performance: an empirical study of the Indian manufacturing sector. *Strategic Management Journal*, 22(10), pp.989–998.

Ramdas, K. (2003). Managing product variety: an integrative review and research directions. *Production and Operations Management*, 12(1), pp.79–101.

Ramdas, K., Fisher, M. and Ulrich, K. (2003). Managing Variety for Assembled Products: Modeling Component Systems Sharing. *Manufacturing & Service Operations Management*, 5(2), p.142.

Ramdas, K. and Sawhney, M.S. (2001). A Cross-Functional Approach to Evaluating Multiple Line Extensions for Assembled Products. *Management Science*, 47(1), pp.22–36.

Randall, T. and Ulrich, K. (2001). Product Variety, Supply Chain Structure, and Firm Performance: Analysis of the U. S. Bicycle Industry. *Management Science*, 47(12), pp.1588–1604.

Rhoades, S.A. (1993). The Herfindahl-Hirschman index. *Federal Reserve Bulletin*, 79(3), pp.188–189.

Richard, P.J. et al. (2009). Measuring Organizational Performance: Towards Methodological Best Practice. *Journal of Management*, 35(3), pp.718–804.

Robinson, K.C. (1999). An examination of the influence of industry structure on eight alternative measures of new venture performance for high potential independent new ventures. *Journal of Business Venturing*, 14(2), pp.165–187.

Robinson, W.T. and Fornell, C. (1985). Sources of Market Pioneer Advantages in Consumer Goods Industries. *Journal of Marketing Research*, 22(3), p.305.

Romanelli, E. (1989). Environments and Strategies of Organization Start-up: Effects on Early Survival. *Administrative Science Quarterly*, 34(3), p.369.

Rosenbloom, B. (2007). Multi-channel strategy in business-to-business markets: Prospects and problems. *Industrial Marketing Management*, 36(1), pp.4–9.

Rosenbloom, R.S. and Christensen, C.M. (1994). Technological Discontinuties, Organizational Capabilities, and Strategic Commitments. *Industrial and Corporate Change*, 3(3), pp.655–685.

Rubin, D.B. (1987). *Multiple Imputation for Nonresponse in Surveys*. New York: Wiley.

Rumelt, R.P. (1982). Diversification strategy and profitability. *Strategic Management Journal*, 3(4), pp.359–369.

Rumelt, R.P., Schendel, D. and Teece, D.J. (1991). Strategic management and economics. *Strategic Management Journal*, 12(S2), pp.5–29.

Sappington, D.E.M. and Wernerfelt, B. (1985). To Brand or Not to Brand? A Theoretical and Empirical Question. *The Journal of Business*, 58(3), pp.279–293.

Sarangee, K.R. and Echambadi, R. (2014). Firm-Specific Determinants of Product Line Technology Strategies in High Technology Markets. *Strategic Entrepreneurship Journal*, 8(2), pp.149–166.

Sawhney, M.S. (1998). Leveraged High-Variety Strategies: From Portfolio Thinking to Platform Thinking. *Journal of the Academy of Marketing Science*, 26(1), pp.54–61.

Scheffer, J. (2002). Dealing with Missing Data. *Research Letters in the Information and Mathematical Sciences*, 3, pp.153–160.

Scheibehenne, B., Greifeneder, R. and Todd, P.M. (2010). Can There Ever Be Too Many Options? A Meta-Analytic Review of Choice Overload. *Journal of Consumer Research*, 37(3), pp.409–425.

Schendel, D. and Hofer, C.W. eds. (1979). *Strategic management: A new view of business policy and planning*. Boston, MA: Little, Brown and Company.
Scherer, F.M. and Ross, D.R. (1990). *Industrial market structure and economic performance*. Houghton Mifflin.
Schlosser, A.E. (2005). Posting versus Lurking: Communicating in a Multiple Audience Context. *Journal of Consumer Research*, 32(2), pp.260–265.
Schmalensee, R. (1978). Entry Deterrence in the Ready-to-Eat Breakfast Cereal Industry. *The Bell Journal of Economics*, 9(2), pp.305–327.
Schomburg, A., Grimm, C.M. and Smith, K.G. (1994). Avoiding new product warfare: The role of industry structure. In *Advances in Strategic Management*. pp. 145–173.
Schumpeter, J.A. (1942). *Capitalism, Socialism and Democracy*. Harper & Brothers.
Schumpeter, J.A. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Transaction Publishers.
Schwartz, B. (2000). Self-determination. The tyranny of freedom. *The American psychologist*, 55(1), pp.79–88.
Selnes, F. (1993). An Examination of the Effect of Product Performance on Brand Reputation, Satisfaction and Loyalty. *European Journal of Marketing*, 27(9), pp.19–35.
Shafir, E. and Tversky, A. (1992). Thinking through uncertainty: Nonconsequential reasoning and choice. *Cognitive Psychology*, 24(4), pp.449–474.
Shankar, V. (2006). Proactive and Reactive Product Line Strategies: Asymmetries Between Market Leaders and Followers. *Management Science*, 52(2), pp.276–292.
Shapiro, C. and Varian, H.R. (1998). Versioning: the smart way to sell information. *Harvard Business Review*, 76(6), pp.106–107.
Shugan, S.M. (1989). Product Assortment in a Triopoly. *Management Science*, 35(3), pp.304–320.
Shughart, W.F.I. (2008). Industrial Concentration. In *Concise Encyclopedia of Economics*. Indianapolis: Library of Economics and Liberty.
Simonson, I. (1990). The Effect of Purchase Quantity and Timing on Variety-Seeking Behavior. *Journal of Marketing Research*, 27(2), p.150.
Sinha, R.K. and Noble, C.H. (1997). The Performance Consequences of Subfield Entry. *Strategic Management Journal*, 18(6), pp.465–481.
Smith, K.G. et al. (1991). Organizational Information Processing, Competitive Responses, and Performance in the U.S. Domestic Airline Industry. *Academy of Management Journal*, 34(1), pp.60–85.
Smith, K.G. et al. (1989). Predictors of response time to competitive strategic actions: Preliminary theory and evidence. *Journal of Business Research*, 18(3), pp.245–258.
Smith, K.G., Collins, C.J. and Clark, K.D. (2005). Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms. *Academy of Management Journal*, 48(2), pp.346–357.

Smith, K.G., Ferrier, W.J. and Ndofor, H. (2001). Competitive Dynamics Research: Critique and Future Directions. In M. Hitt, R. E. Freeman, & J. Harrison, eds. *Handbook of Strategic Management*. London: Blackwell Publishers.

Smith, K.G., Grimm, C.M. and Gannon, M.J. (1992). *Dynamics of competitive strategy*. London: Sage Publications.

Sørensen, J.B. and Stuart, T.E. (2000). Aging, Obsolescence, and Organizational Innovation. *Administrative Science Quarterly*, 45(1), p.81.

Sorenson, O. (2000). Letting the Market Work for You: An Evolutionary Perspective on Product Strategy. *Strategic Management Journal*, 21(5), pp.577–592.

Staw, B.M. (1991). Dressing Up Like an Organization: When Psychological Theories Can Explain Organizational Action. *Journal of Management*, 17(4), pp.805–819.

Stern, I. and Henderson, A.D. (2004). Within-business diversification in technology-intensive industries. *Strategic Management Journal*, 25(5), pp.487–505.

Stevens, J.P. (1984). Outliers and influential data points in regression analysis. *Psychological Bulletin*, 95(2), pp.334–344.

Stinchcombe, A. (1965). Social structure and organization. In J. G. March, ed. *Handbook of Organizations*. Chicago, IL: Rand MacNally, pp. 163–193.

Stolzenberg, R.M. (2004). Multiple Regression Analysis. In M. Hardy & A. Bryman, eds. *Handbook of Data Analysis*. London, UK: SAGE Publications, Ltd, pp. 165–208.

Szymanski, D.M. and Henard, D.H. (2001). Customer Satisfaction: A Meta-Analysis of the Empirical Evidence. *Journal of the Academy of Marketing Science*, 29(1), pp.16–35.

Tanriverdi, H. and Lee, C.-H. (2008). Within-Industry Diversification and Firm Performance in the Presence of Network Externalities: Evidence From the Software Industry. *Academy of Management Journal*, 51(2), pp.381–397.

Teece, D.J. (1980). Economies of scope and the scope of the enterprise. *Journal of Economic Behavior & Organization*, 1(3), pp.223–247.

The Oxford Dictionary of English. (2005). Definition of 'competition'. *The Oxford University Press*.

Tirole, J. (1988). *The theory of industrial organization*. Cambridge, MA: MIT Press.

Toyoda, K. (2006). Digital still cameras at a glance. In J. Nakamura, ed. *Image Sensors and Signal Processing for Digital Still Cameras*. Boca Raton, FL: CRC Press, pp. 1–20.

Tsai, W., Su, K.-H. and Chen, M.-J. (2011). Seeing Through the Eyes of a Rival: Competitor Acumen Based on Rival-Centric Perceptions. *The Academy of Management Journal*, 54(4), pp.761–778.

Tushman, M.L. and Anderson, P. (1986). Technological Discontinuities and Organizational Environments. *Administrative Science Quarterly*, 31(3), p.439.

van Valen, L. (1973). A New Evolutionary Law. *Evolutionary Theory*, 1, pp.1–30.

Van de Ven, A.H. (1992). Suggestions for studying strategy process: A research note. *Strategic Management Journal*, 13(S1), pp.169–188.

Venkatraman, N. and Ramanujam, V. (1986). Measurement of Business Performance in Strategy Research: A Comparison of Approaches. *Academy of Management Review*, 11(4), pp.801–814.

Villa, J.R. et al. (2003). Problems with detecting moderators in leadership research using moderated multiple regression. *The Leadership Quarterly*, 14(1), pp.3–23.

Vlaskovits, P. (2011). Henry Ford, Innovation, and That "Faster Horse" Quote. *Harvard Business Review*. [online]. Available from: https://hbr.org/2011/08/henry-ford-never-said-the-fast [Accessed October 25, 2018].

Vroom, V.H. (1964). *Work and motivation*. Oxford, England: Wiley.

Wiggins, R.R. and Ruefli, T.W. (2002). Sustained Competitive Advantage: Temporal Dynamics and the Incidence and Persistence of Superior Economic Performance. *Organization Science*, 13(1), pp.82–105.

Williams, M.N., Grajales, C.A.G. and Kurkiewicz, D. (2013). Assumptions of multiple regression: Correcting two misconceptions. *Practical Assessment, Research & Evaluation*, 18(11), pp.1–14.

Williams, P. and Naumann, E. (2011). Customer satisfaction and business performance: a firm- level analysis. *Journal of Services Marketing*, 25(1), pp.20–32.

Wilson, L.O. and Norton, J.A. (1989). Optimal Entry Timing for a Product Line Extension. *Marketing Science*, 8(1), pp.1–17.

Xiao, J. (2008). Markov Perfect Equilibrium in the US digital camera market. *International Journal of Industrial Organization*, 26(5), pp.1233–1249.

Ye, G., Priem, R.L. and Alshwer, A.A. (2012). Achieving Demand-Side Synergy from Strategic Diversification: How Combining Mundane Assets Can Leverage Consumer Utilities. *Organization Science*, 23(1), pp.207–224.

Young, G., Smith, K.G. and Grimm, C.M. (1996). 'Austrian' and Industrial Organization Perspectives on Firm-Level Competitive Activity and Performance. *Organization Science*, 7(3), pp.243–254.

Yu, T. and Cannella, A.A. (2007). Rivalry Between Multinational Enterprises: An Event History Approach. *Academy of Management Journal*, 50(3), pp.665–686.

Zahavi, T. and Lavie, D. (2013). Intra-industry diversification and firm performance. *Strategic Management Journal*, 34(8), pp.978–998.

Zeithaml, V.A. (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *The Journal of Marketing*, 52(3), pp.2–22.

Zhu, F. and Zhang, X. (Michael). (2010). Impact of Online Consumer Reviews on Sales: The Moderating Role of Product and Consumer Characteristics. *Journal of Marketing*, 74(2), pp.133–148.

Zimmerman, D.W. (1994). A note on the influence of outliers on parametric and nonparametric tests. *The Journal of General Psychology*, 121(4), p.391.

Zimmerman, D.W. (1995). Increasing the Power of Nonparametric Tests by Detecting and Downweighting Outliers. *The Journal of Experimental Education*, 64(1), pp.71–78.

Zuckerman, E.W. (1999). The Categorical Imperative: Securities Analysts and the Illegitimacy Discount. *American Journal of Sociology*, 104(5), pp.1398–1438.